PUBLIC WORKS

CITY COUNTY STATE

MAY, 1927

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PUBLIC WORKS
CITY COUNTY STATE
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Vol. 58 May, 1927 No. 5

Highway Safety

More than 100,000 persons have been killed in automobile accidents in the United States during the past five years. There are no official figures for the injured but they undoubtedly exceeded half a million, while the property damages are estimated to have reached $200,000,000. This means a loss to the country valued at one and a quarter billion dollars, or one-fourth of the total expenditures for highways during that period. And what value can be placed on the personal loss suffered by the relatives and friends of those killed and maimed?

Part of such loss can be prevented by education and enforcement of wise traffic regulations. But no regulations can be highly effective unless the designing, constructing and maintaining of our highways be performed with the definite purpose continuously in mind to make them as nearly accident-proof as possible.

What the several state highway departments are doing along this line is discussed in this article.

During the past few years tons of matter have been written concerning the advantages of improved highways to the country, and other tons concerning the best methods of constructing highways in order to promote convenience and cheapness of transportation and durability of the street surface. The time has come when more attention should be paid by promoters, engineers and executives to another phase of the highway problem.

With the increased traffic which improved roads and cheap automobiles have created there has come rapidly to the front the important feature of safety of travel on these highways. The thousands who are maimed and killed every year on the highways of the country make it necessary to consider as of the greatest importance what move can be made to minimize the possibility or probability of such accidents. Roads can probably never be made fool proof, but at least we can do something towards aiding the reasonably intelligent man to protect himself against injury from his own acts or those of other travellers on the highway.

The measures to be taken to this end may be divided into two general classes—the formulating of laws and regulations and the enforcing of them; and the providing of such physical features of construction and appurtenances as will forward this purpose.

MEASURES TAKEN BY THE DIFFERENT STATES

During the past few weeks we have asked the state highway officials of all the states to inform us what their respective states are doing or contemplated doing towards traffic control and safety. An inspection of the replies indicates that the majority of the states are appreciating the importance of the subject. A number, however, do not appear to be taking seriously, as a problem for the state highway department at least, the importance of safety measures. In some states, such as Montana, traffic is still so light that there might appear to be little immediate necessity for such measures. But even in these states, the officials should be warned by others and take such measures, in advance of the growth which probably will take place in their traffic, as will anticipate and forestall conditions which will make such accidents probable or possible.

THIS BRIDGE IS AS SAFE AS ANY PART OF THE ROAD
Bridge full width of roadway, including shoulders, over Waples Mill pond, Delaware.

The safety measure which is found to be most common among the states is that of abundant placing of road signs, both direction and cautionary signs. Especial activity along these lines is reported by Colorado, Michigan, Nebraska, Nevada, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Vermont and West Virginia. Some of the states, like Michigan, are employing flash signals at certain points. Mississippi

especially reports railroad caution signals at grade crossings. The painting of center lines at curves is reported by Pennsylvania and by Iowa.

A most important measure, and also a very expensive one, is the elimination of grade crossings. Work along this line is reported by Michigan, Mississippi, Oklahoma, Utah, Connecticut, Iowa and Pennsylvania. The last three states also report that they are eliminating dangerous curves by lengthening the radius or by clearing out obstructions to sight on the inside of the curves. Widening roads also as a safety measure is reported by some of these states. A measure reported by Connecticut is the maintenance of detours during construction and the handling of the traffic at the detours by means of state police.

GRADE SEPARATION IN ST. CLAIR COUNTY, MICH.
Full width roadway under Grand Trunk R. R.

From Michigan, G. C. Dillman, deputy commissioner and chief engineer, reports: "Railroad crossing are being eliminated by relocation or by grade separation. In certain cases grades of important trunk lines are being separated where the topography is favorable. Flash signals at railroad crossings and at dangerous road intersections in certain cases."

W. H. Connell, engineering executive and deputy secretary of highways, reports for Pennsylvania: "Improvements in the highways are made to provide maximum safety for the users of the roads. Sharp curves are eliminated; grades lightened; relocations made to eliminate railroad grade crossings. Caution and danger signs, including reflector signals for night driving, are placed to warn the motorists of dangerous conditions ahead. A white band is painted on the pavement to divide the traffic at all curves. Guard rail is placed at all dangerous embankments. In short, all dangerous physical features of the roadway are eliminated, in so far as practicable and possible with existing funds."

From Rhode Island, G. H. Henderson, chief engineer of the State Board of Public Roads, says: "In the matter of traffic control and safety, would say that this department is fostering a bill at present in the Legislature which will permit us to build wider pavements on tangents. Under the classification 'betterment work' we are each year eliminating as many dangerous places along our state highways as our funds will permit by improving the alignment, widening on curves and sharp angles, cutting back the banks to improve vision and in some cases even removing buildings and other obstructions. We have adopted the national standard danger and warning signs approved by the American Association of State Highway officials and are placing these as rapidly as possible on all of our state highways."

Virginia reports it is lengthening vertical curves and lightening and flattening, widening and superelevating horizontal curves.

Among the measures taken other than physical, we find Virginia taking a traffic census; and in a number of the states, the highway departments are using their influence to have the legislature pass laws regulating the speed of traffic, providing more police or other agents for enforcement of the traffic laws, etc.

Rhode Island in 1925 created a Department of State Police which is doing excellent work in controlling traffic, and the present legislature passed an act increasing this force by ten men.

One of the regulations in Michigan requires all vehicles to stop before entering state trunk line roads; and Utah also is establishing what it calls arterial highways and traffic from side lanes and streets is required to come to a stop before entering such highways. The same idea is reported as recently having been adopted in Ontario and will be enforced during the coming season.

"Pennsylvania, through its Department of Highways," says Mr. Connell, "is doing everything possible to make the highways safe for the travelling public. There is a force of about 300 highway patrolmen constantly patrolling the roads to enforce the motor vehicle laws and regulations; to educate the motoring public in use of the highways; and to render assistance in case of accident. All motor vehicle operators are licensed. New applicants for operators licenses must pass an examination before they are qualified to drive. The department of highways, through its motor patrol, prosecutes to the full extent of the law persons operating motor vehicles without proper credentials or while under the influence of liquor."

BRIDGE WIDTHS.

A cause of more or less frequent accidents on a number of highways is the narrowness of the bridges as compared with the roadway leading to them. Such accidents are generally due to one of two causes; one that the car approaching the bridge does not notice that it is narrower than the roadway until too near to change its course, and then either endeavors to climb the end of the truss or coping wall or else goes over the bank of the approach. The other is the endeavor, when two cars meet at a bridge too narrow to allow them to pass on it, of each car to reach the bridge ahead of the other, with the result that they collide on the bridge, one or both of them is forced into the truss or coping wall: or when one car endeavors to speed ahead of another on such a bridge a similar accident is probable.

Most state highway departments recognize that the roadway of a bridge should be as wide as, and a continuation of, the line of the roadway on each end of it; otherwise it serves as a greater or less obstruction to traffic on the roadway and as a possible cause of accident.

Nine of the states report that it is their practice to make all culverts and bridges as wide as the entire roadway, both paved portion and shoulders, while Massachusetts states that it makes its bridges even wider than this.

CONCRETE BRIDGE FULL WIDTH OF ROAD.
Two spans over Pequannock river, New Jersey.

Fifteen states report the practice of making all culverts as wide as the entire roadway including shoulders, but the bridges are not made so wide. One of these, however, makes its slab bridges as wide as the roadway and all other bridges up to the span of 22 feet. One state makes its bridges a minimum of 30 feet wide, with 40 feet on its primary roads. Seven others make all bridges with 20 foot roadways. Two make slab and deck girder bridges 24 feet wide, and truss bridges 20 feet wide. One state reports that roadways on all two-lane bridges are made 24 feet wide, with 3-foot to 5-foot sidewalks additional in populous sections, near schools, etc.

STEEL TRUSS BRIDGE FULL WIDTH OF ROADWAY.
Four-span bridge with draw over Mullica river, New Jersey.

Nine report that both culverts and bridges are made of less width than the roadway, four of these 20 feet wide, two 24 feet, and one 18 feet.

The above refers to the states of the United States. Of Canadian provinces reporting, two of them make the bridges as wide as the roadways; two make the culverts as wide but one makes bridges only 24 feet and the other only 17 feet; while the fifth makes culverts and bridges only 18 feet wide.

STANDARD WIDTHS OF ROADWAYS.

Collisions and other accidents are frequently due, directly or indirectly, to too narrow roadways, curves that are too sharp or obstruct the views ahead, or grades that are too steep.

Eighteen feet appears to be the favorite standard width for main roads, twenty-four of the states reporting this width, two of them also using 20 feet standard on some roads, while one has standards as high as 30 feet and another as high as 40 feet.

The next most common standard width for main roads is 20 feet, six states reporting this, one having one road with a 40-foot standard width, while another has standard as high as 27 feet.

Two states still have standard as low as 16 feet, although one of these has also 18 feet as a standard and the other both 18 and 20 on some highways.

Twenty-one feet is used as a standard in one state, 24 to 40 feet in one state, and 27 feet in one state.

For roads other than main roads, one state has a standard as low as 12 feet; one as low as 15 in one case and 18 in others. In eighteen of the states however, 18 feet is the standard, two of these also using a 20 foot standard. Nine states report 16 feet as their standard, although two of them alsc have 18 feet standard widths on some roads other than main roads. Several of the states report that they have no standards for these roads.

CURVATURE.

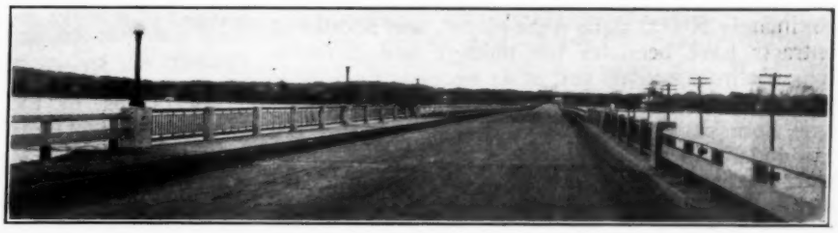
The sharpest allowable curvature varies widely in the different states from 100 feet to 500 feet expressed as feet, and from 38° to 4° when expressed as degree of curvature. Five states report 500 feet, four states 200 feet (one of these in the mountain sections only), three states 300 feet, two states 250 feet, and one state 350 and one state 100 feet. Two states report 28° curvature, two states 10°, two states 6° curvature, and two states 4°; while no other degree of curvature is reported by more than one state, the curvatures used being 38°, 30°, 23°, 19°, 11½°, 5½°, and 5°.

MAXIMUM GRADES.

In the matter of maximum grades set as a limit for improved highways, there is much more uniformity than in that of curvature. Sixteen states report 6% as the maximum grade, six report 7%, 5 report 5%, 3 report 8% (although two of these limit it to 7% in some parts of the state, and one to 6%); and one reports 9%, although in only a few cases do the roads exceed seven.

Indiana's Speed Limits 40 and 20 Miles

Indiana has set the legal maximum speed limit on rural highways at forty miles an hour. This is in line with the present development of traffic and the safety now built into modern cars. The man who prefers to drive at thirty-five may still do so, but it is now illegal to travel the main roads of Indiana at twenty miles, or so slow a rate as to endanger traffic that is going at the legal rate. This phase of the law will permit police officers to speed up traffic when there is congestion. The same law makes it obligatory for police officials to keep records of those



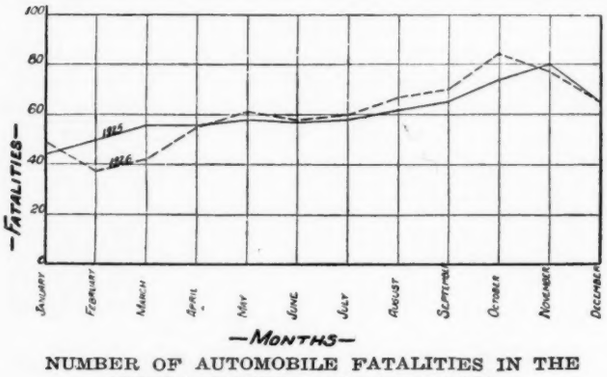
FULL-WIDTH BRIDGE OVER MANASQUAN RIVER, NEW JERSEY.
Concrete incased deck plate girder, with sidewalk.

who habitually are in accidents and report them to the Indiana Secretary of State, who has the right to prohibit them from driving in the future.

Auto Accidents Increase in 1926

It is estimated that 23,000 persons were killed in automobile accidents in 1926. This figure includes deaths from collisions of automobiles with railroad trains, street cars and other heavier vehicles as well as other types of motor vehicle accidents, and includes about 300 deaths from motorcycles.

A recent release of the census bureau covering accidents in 1925 shows that the total automobile accidents not including motorcycles were 21,627, which figure is increased to 21,930 including motorcycle accidents.



NUMBER OF AUTOMOBILE FATALITIES IN THE UNITED STATES, DAILY BY MONTHS.

The 1926 record is an increase of 4.5 per cent over 1925, whereas the 1925 fatalities were approximately 9 per cent in excess of the deaths occurring in the year 1924. The percentage increase is decreasing.

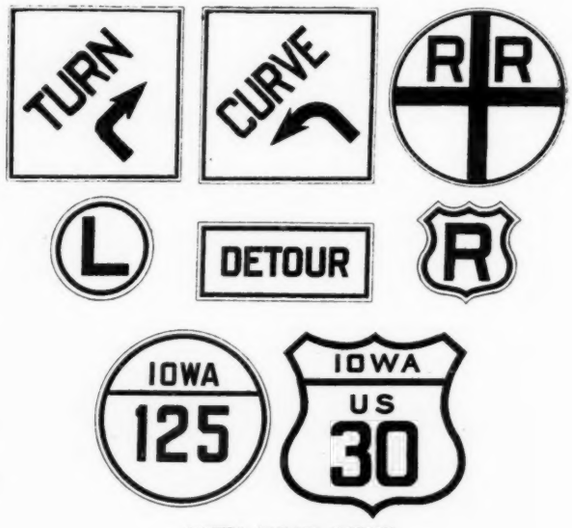
The accompanying chart shows the number of persons killed each day during each month of the year, the solid line representing the record for 1925 and the dotted line the record for 1926. The early months of 1926 showed an improvement.

Iowa Road Signs

Iowa, like the majority of other states, has adopted the uniform system of caution, warning danger and direction signals devised by the United States Joint Interstate Highway Commission, and recommended for use on interstate and state highway systems. The new markers and signs were placed on the Iowa primary road system during the first few days of October, 1926, the work being carried out in each county by the county maintenance department. Approximately 50,000 signs were placed, and additional contracts have been let for mileage and direction signs for intersections and other necessary places.

In the design of markers, caution and warning signs, both shape and color have been utilized. All road and route number markers, mileage and direction signs are on a white background, with black lettering. Number markers are round for the primary system and shield-shaped for the interstate system. All warning, caution, and danger signs are on a yellow background, with black lettering, and with the exception of the railroad crossing signs, are square or rectangular in shape. The driver of a motor vehicle, approaching a square or a yellow sign, will know that there is danger ahead, and should proceed with caution.

That part of the primary road system which has been included in the interstate system is marked by the shield, instead of the Iowa circle marker, which is used on the remainder of the primary system. There are no duplicate numbers, the primary and the U. S. numbers together forming one consecutive series of numbers covering every road in the state system.



IOWA ROAD SIGNS.

TOP LINE.

Turn sign—yellow background, square shape. 24 inches in size. Gives warning of turn in road in direction in which arrow points. Found at right angle turns.

Curve sign—yellow background, square in shape. Color and shape both indicate caution or warning. Sign used to warn motor vehicle driver to be on lookout for curve in road in direction in which arrow points.

Railroad crossing sign—round, 24 inches in diameter, yellow background, cross bars with letters in black. Two horizontal cross bars indicate double track railway.

MIDDLE LINE.

Direction sign—round, 9 inches in diameter and same style as primary road marker. Shows direction when approaching road turns. "L" in circle indicates road turns to left.

Detour—black letters on white background, size 8"x18". Used to indicate temporary routing while improvement work is in progress on main roads.

Direction sign—U. S. shield of approximately same size as the primary direction marker used on roads marked with U. S. route marker. "R" indicates road turns to right.

BOTTOM LINE.

Primary road marker—16 inches in diameter—carries the word "Iowa" and the road number in black letters on a white background. Used on all sections of the primary road system except those in the U. S. Interstate system.

U. S. route marker—same approximate size as primary marker—letters and road number in black on white backgound.

State Maintains Detours

According to the terms of a recent law, the Indiana State Highway Department must maintain suitably all detours of State highway sections under construction. In the past, when highways have been built, traffic has been detoured over county, township, or even improvised roads. Local units, such as counties or townships, have given very little attention to the care of detour roads. This lack of

care may have been due to shortage of funds, but whatever the reason, the result has nearly always been the same. Detours uniformly have been unmarked and nearly impassable. Only in very recent years has there been any recognition of the rights of road users to a well-marked, well-maintained detour, and even yet the idea does not seem to have reached all sections.

The new Indiana law means that detours made necessary by the construction of State highways will be kept in good shape. The cost is estimated at upward of $750,000 a year. The State Highway Department will be forced to spend this amount on maintaining roads not in its system and not of a permanent character, and thus will be able to build less road; but the law will be appreciated by the traveling public.

How to Make a Traffic Survey*

By Miller McClintock†

Guesswork is no more fruitful of beneficial results in street traffic control than in any other engineering problems. Politics should be kept out of traffic engineering, because it may result in considering the matter in the light of local or regional conditions, instead of as a whole. Sponsorship is essential to a successful traffic survey, and the sponsoring body should consist of representatives from all interests that feel they have a share in the use of the streets, such as street railways, motor car dealers, automobile clubs, retail merchants, taxicab operators, motor coach operators, insurance and cartage companies, and building owners.

For survey purposes, the services of traffic engineers are required. Methods employed for the collection of data depend on both the staff and the funds available. An outline of typical procedure is as follows:

I. The study of existing traffic. A census and analysis of traffic flow at important points throughout the city, including data on the following factors: Volume; direction; speed; types of vehicles; hourly variations.

A study of the operation conditions and problems of various vehicle types: Street cars; commercial vehicles; private passenger cars; taxicabs; buses.

A study of the concentration of traffic in the central business district through the making of a cordon count on a typical business day of both the total number of vehicles entering the district and the total number of persons entering the district.

II. An analysis of the parking problems; a study especially applicable to the central and outlying business districts showing the capacity of the districts for parking; current practice in parking; amount of traffic obstruction offered by parking, and existing and potential off-street storage facilities.

III. Collection and tabulation of existing data on accidents. This not a study that can be completed satisfactorily in a short period. The collection of accurate information over a period of months, and even years is requisite for confident generalization. The report forms and methods of the National Safety Council are recommended.

IV. The relation between traffic and business, covering a computation of trucking and other transportation costs attributable to traffic congestion; the effect of traffic upon accessibility of retail establishment; and the relations between parking and retail trade.

V. A study of physical obstructions, as follows: Street design; pavement conditions; private use of streets, including merchandising, signs, posts, boxes, building encroachments and storage of materials; and street openings.

VI. The effectiveness of existing regulations such as through street-stop regulations, left turn rules, operation of signal lights, overtaking movements, relation between street cars and vehicles, and pedestrian regulation.

VII. Study of police operation: Enforcement methods; directive methods; adequacy of personnel, as to numbers, training, and equipment.

VIII. Functioning of the courts: Volume of cases handled; classification of cases; disposition.

Recommendations based on such a survey will naturally fall into two sections: Those concerning the formulation of a simple traffic code and those concerning administrative changes to make the future control of traffic more effective.

* Abstract of paper before 15th Annual Safety Congress.
† Director, Albert Russell Erskine Bureau of Street Traffic Research in Harvard University, and Metropolitan Street Traffic Survey, Chicago Association of Commerce.

The Cuban Central Highway

Contracts have been let and construction has begun on the Central Highway of Cuba, which extends from Pinar del Rio to Santiago, a distance of 705 miles. As estimated from unit prices and quantities, the work, which is to be completed in five years, will cost about $75,000,000. This price includes grading, drainage, bridges, and other work, as well as paving.

The pavement width is 6.3 meters (about 20.7 feet) including concrete curbs. On about 80 per cent of the total length, Warrenite-bitulithic will be used on a concrete base; the remainder of the road, mainly those sections near important cities where traffic is expected to be heavy, will be paved with granite blocks on a concrete base. Base for both pavements will be 6 inches thick at the center and 9 inches at the edges, of 1:2½:5 concrete. Where bridge spans are greater than 30 meters (about 100 feet) steel will be used; culverts and bridges of shorter span will be of reinforced concrete.

Since prices may change materially during the period of construction, a sliding scale is provided, so that if labor or basic materials should rise or fall more than 5 per cent in price, 80 per cent of the advance or decline will be added to or subtracted from the unit contract price.

Contracts were awarded to Warren Bros. Co., Boston, Mass., covering approximately 70 per cent of the work, and to the Associated Cuban Contractors, Inc., for the remaining 30 per cent.

Refuse Collection and Disposal in Toronto

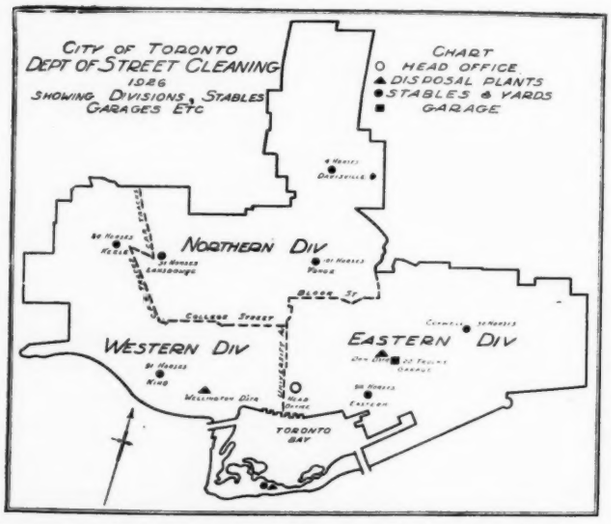
All combustible matter burned in destructors. Tractor and trailer system of collection being extended. Department builds its own wagons, fills brooms, etc. Street cleaning and oiling.

The annual report of George W. Dies, street commissioner of Toronto, Ontario, for the year 1926 gives a very complete description of the organization and functioning of the Department of Street Cleaning of that city. We have endeavored to give in the following paragraphs some of the more interesting and important features of this report.

The activities of the department include cleaning the public thoroughfares, collecting and disposing of the municipal refuse, cleaning catch-basins, oiling unimproved roadways, and removing snow from the downtown section and the main car line.

ORGANIZATION

For purposes of supervision the city is divided into three main divisions, each controlled by a divisional superintendent. These divisions are divided into foremen's districts, each of which is subdivided into three sections, representing the three successive days of each semi-weekly collection. A fourth divisional superintendent controls the operation of three refuse disposal plants and the departmental garage. The department employs an average of 990 men. During the winter season 525 drivers and vehicles are engaged in the collection of refuse, while during the summer months 390 drivers and vehicles are so engaged. The peak number engaged in street cleaning service during the summer is 165 patrolmen and 46 drivers and vehicles. Ninety-five men are engaged continuously at the refuse disposal plants. The office staff, foremen, stablemen, watchmen, shop and garage men comprise the balance of the force.



STREET CLEANING DIVISIONS OF TORONTO; LOCATION OF DISPOSAL PLANTS, STABLES AND GARAGE

Each divisional superintendent has an office in the main yard of his division, where the time sheets are prepared, records maintained and reports made incidental to the operation of his division. The superintendent of incineration has an office at the garage.

For refuse collection purposes, the area of the city is divided into 23 foremen's districts, each of which is subdivided into three sections to provide for the semi-weekly collections. The average area of each district is 900 acres with an average of 24.34 miles of street and 6.3 miles of lanes. For street cleaning purposes there are 5 foremen's districts comprising the downtown and principal business section, each with an area of 2,160 acres; while the remaining section, or ten districts, is under the jurisdiction of the refuse collection foreman, who supervises the street cleaning work in conjunction with the collection service.

STREET CLEANING

The street cleaning service includes the patroling of the improved roadways, flushing streets, removing snow, cleaning culverts, and oiling unimproved roadways.

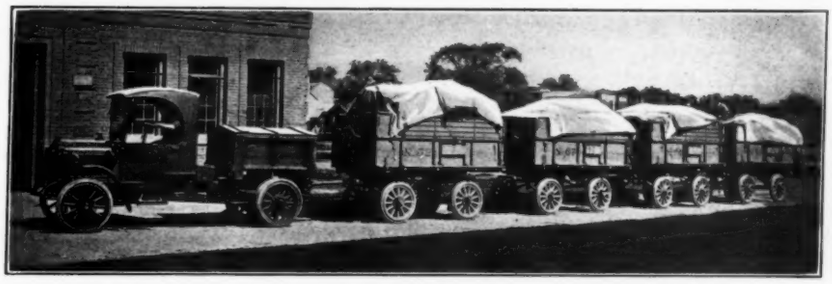
Sweeping by hand is the most generally used method and practically the only system which, in Mr. Dies' opinion, can be applied effectively to business and congested areas. When operated in conjunction with motor flushers it has proved to be most efficient and economical.

The number of patrolmen in 1926 was 167 which, while greater than the previous three years, was considerably less than it had been before the war, there having been 428 in 1913. The weekly wages of patrolmen increased from $13.50 in 1913 to $28.80 the past seven years. Although the population has increased about 18 per cent since 1914, the expenditures for patrolmen has decreased from $301,000 to $251,787 last year. The street mileage of improved streets has increased from 336½ miles in 1913 to 467½ last year. In addition to the improved streets, there are 94 miles of unimproved streets.

The average mileage maintained by each patrolman last year was 3.4, or about 50,000 square yards. This is believed by Mr. Dies to be entirely too great an area to be properly maintained by one patrolman, but the funds appropriated for the purpose do not permit the employment of more men. Ten years ago patrolmen had an average of only 1.4 miles of street to maintain.

The $251,787 covers the total cost, including foremen, labor, cartage and supplies. The area of improved street mileage is 7,332,311, giving a cost of maintenance per thousand square yards of $34.34

for the season. This was the cost for an average of 84 sweepings during the season giving the cost of sweeping, collecting and removing of 40.7 cents per thousand square yards. The amount of sweepings collected was 87,796 cubic yards, giving a cost of $2.86 per cubic yard, and 12 cubic yards removed per thousand square yards of pavement.



TRACTOR AND TRAILERS ENTERING INCINERATOR.

Catch-basins are usually cleaned early in the spring, immediately after the general clean-up of the streets, which is usually sufficient until fall when each culvert is again cleaned. Many of the culverts in the business sections are regularly cleaned during the summer season owing to the exceptional amount of refuse which finds its way to the catch-basins due to the flushing of the streets. Considerable trouble has been experienced due to the practice of contractors of mixing concrete on the roadways and flushing the residue into the culverts. Many blocked culverts have been found with catch-basins filled with concrete and requiring the employment of special means for removing same. The cost of cleaning catch-basins last year was 33c per cleaning or $1.69 per cu. yd. cleaned and removed. The number of basins cleaned was 48,183.

The city has a number of flushers consisting of oval tanks and centrifugal pumps mounted upon motor trucks, but during 1926 only three flushers were in operation, two of them being electric trucks purchased in 1913, for night flushing in the downtown section. The reasons given for not using more of the gasoline trucks were that they were needed for other service, and lack of funds. The street mileage flushed last year was 1,615 at a cost of $3.25 per mile or 13.9 cents per thousand square yards. In 1922, 7,156 miles was flushed.

ROAD OILING

Oiling of unimproved roadways is usually commenced early in the spring, as soon as the roads are sufficiently dry to absorb the oil, and discontinued in October or November. This work was formerly done by 9 team wagons but is now performed by one 5-ton motor truck equipped with a steel tank of 1,170 gallons capacity. The oil is applied cold by means of a 2½-inch perforated horizontal pipe 8 inches from the ground, the flow of oil being controlled by a valve operated by the conductor on the rear platform.

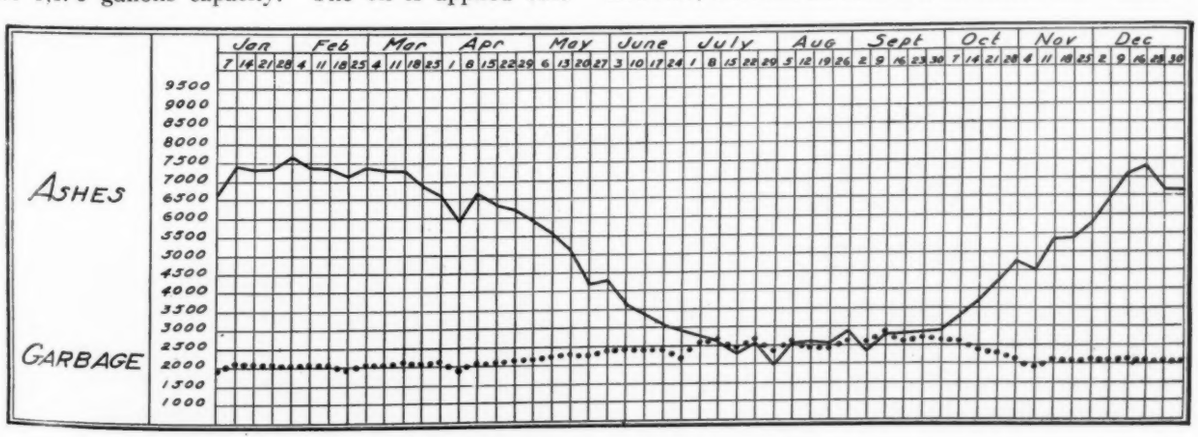
The city has four oil storage tanks with a total capacity of 120,000 gallons, erected in 1920 in corporation yards in four different sections of the city. This permits it to take advantage of low prices and always have oil in case of emergency, and also to load the distributing truck at a point comparatively near to the roads to be oiled, which enables the truck to distribute each day four loads of about 4,680 gallons of oil. About fifty miles of unimproved streets receive an average of three applications of oil per season. The cost last year averaged $14.65 per thousand square yards or $171.81 per mile per application, or 9.66 per gallon of oil used.

SNOW REMOVAL

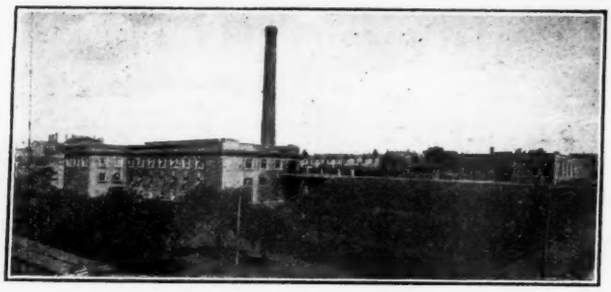
Snow removal in Toronto is confined to the street car lines, main thoroughfares, downtown and the business sections, while the crossings only are kept clear of snow on other streets. Snow removal is performed by the Department of Works and the Department of Street Cleaning, each having a defined area. The Transportation Commission pays 30 per cent of the cost of snow removal from street car and bus lines and in addition maintains its own gang for switches and yards. Last year 48,990 loads of snow were removed at a cost of $76,112.

REFUSE COLLECTION

For collection purposes, householders are required to separate the refuse into two classes which the city designates as ashes and garbage. "Garbage," however, contains all combustible matter and "ashes"



TORONTO REFUSE COLLECTION CHART FOR 1926.
Heavy line indicates loads of ashes removed; dotted line, loads of garbage removed.



DON DESTRUCTOR AND GARAGE.

includes bottles, crockery and other non-combustible matter. Combustible matter is disposed of in two destructors and an incinerator. The non-combustible matter is deposited on dumps.

For collecting the waste, the city still has 50 old 1½ yard dump carts in service, but these are being rapidly replaced with modern roller type dump wagons and trailers with capacities of 4 and 6 yards, and it is expected that by the end of 1928 the small dump carts will be entirely done away with.

During the summer months the collection is performed by 340 city-owned vehicles, 40 hired carts and 10 city-owned trucks and tractors. It is the desire of the department to gradually increase the number of city-owned vehicles until it will be unnecessary to hire outside service during the summer season, hired cars being engaged only in the fall to take care of the additional ash collection. At present the hired vehicles are gradually increased in the fall to 150 and the city-owned vehicles to 375 and city-owned trucks to 14, the extra ones being transferred from the street cleaning service.

The department inaugurated the trailer system for removing refuse in 1919, when 24 wagon trailers were placed in operation. This number has been increased each year and last year there were 87 trailers in service and 10 new ones were under construction in the department's shops. The trailer system has been found to be most economical for collection and most advantageous for long hauls, which are now necessary to deliver the material to the disposal plants. Each trailer carries about 3000 pounds of refuse and is hauled by horse while being loaded. It is left at a designated point to be picked up later by a tractor truck. The trailers are hauled in trains of four to the disposal plants.

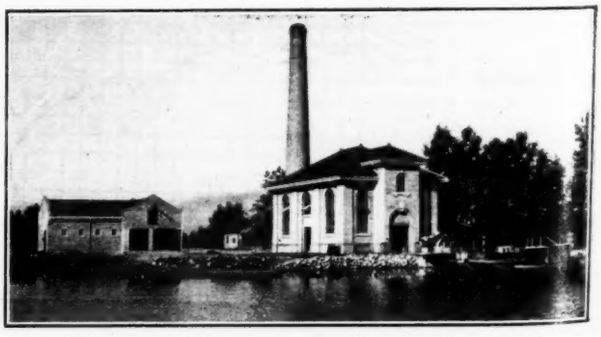
Last year the department collected 264,361 tons of non-combustible and 138,654 tons of combustible waste at a total expenditure of $842,237. This expenditure includes labor, hired service and supplies. Adding the cost of administration, insurance, compensations, feeding and care of horses, repairs to vehicles, and upkeep of plant, brought the total to $1,108,118.

Refuse was collected from 117,403 buildings, with an average of 100 calls per building during the year. The actual cost per collection per building was 7c, or 9c total cost; while the total cost per ton was $2.74 and per building per year $9.43. An average of 3.4 tons of both ashes and garbage was collected from each building during the year.

The older of the city's two destructors, situated on the Don river, was placed in operation in July, 1917, and cost $225,000 exclusive of land. It consists of three high-temperature 4-cell Sterling furnace units, with combustion chambers, connecting flues, and all appurtenances, including air heaters or regenerators. A brick chimney 175 feet high with an internal diameter of 90 inches at the base is located 25 feet from the building. The plant has a guaranteed capacity of 180 tons per 24 hours, but has consumed as much as 200 tons in 16 hours. The collecting equipment which brings the refuse to the incinerator passes over a weigh scale outside the building, where the weights are recorded. The refuse is then dumped from a tipping floor onto a charging floor, where there is storage capacity for 200 tons. It is then dragged into the charging containers and from them is automatically discharged through feed holes into the furnaces, the charges being controlled by the stokers on the stoking floor. Each furnace receives 350 to 400 charges during an eight-hour period. Clinker and ashes pass through chutes in the floor into an ash run below, where they are emptied into steel side-dump trucks. These trucks are run onto an elevator and lifted up and discharge the ash at the ground level, whence it is removed by motor trucks.

In 1926 52,081 tons of refuse were disposed of at an actual labor cost of 1.5 man-hours of labor per ton, this including tipping floor man, charging men, stokers, ash run men, and the removing of ash residue; this being the actual labor engaged in the disposal of the refuse. The total labor cost amounts to two man-hours per ton, this including actual labor cost plus supervision, weigh scale clerk, and privileges accorded to employees of the department consisting of a half-day off per week with pay, all statutory holidays, two weeks' holidays, and sick pay to the extent of one month's wages. Adding all supervision, materials and supplies, and repairs to plant, give a total of 2.5 man-hours of labor per ton of refuse destroyed. In dollars, the labor cost was $68,558, or $79,500 including maintenance. This gave a labor cost per ton of $1.31 and a total cost of $1.52. Ash residue amounted to 10 per cent of the total tonnage destroyed.

The second destructor is situated on Wellington street and was placed in operation April 1925. It cost $550,000 exclusive of land and consists of four Sterling 4-cell furnaces complete with combustion chambers, air heaters, connecting flues, and all appurtenances, including forced draft equipment, air compressors and temperature recording instruments. There are two chimneys 175 feet high, and the arrangement of flues is such that it is possible to op-

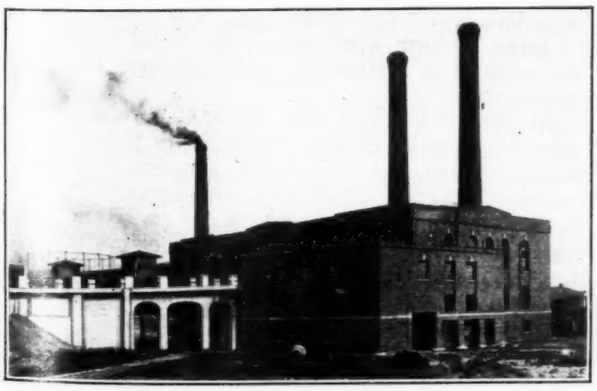


ISLAND INCINERATOR AND STABLE.

erate a battery of three furnaces on one chimney, so that at any time the plant may be operated at not less than 75 per cent capacity. The guaranteed capacity is 400 tons per 24 hours but it has destroyed 360 tons in a 16-hour day. The tipping floor is so arranged that it is possible to dump the material from the vehicles on both sides of the charging floor, which makes it possible to dump 40 rear-dump vehicles at one time, which is a decided improvement over the Don destructor. The capacity of the charging floor is such that it is possible to store sufficient material in an eight-hour delivery to operate the plant for 24 hours. Last year this plant disposed of 69,822 tons of refuse at an actual cost of 1.3 man-hours of labor per ton or a total labor cost amounting to 1.7 man-hours of labor per ton, and 1.9 hours including materials, supplies, repairs, etc. In dollars, the labor cost was $1.03 per ton and the total cost $1.13 per ton. The ash residue amounted to 10.6 per cent of the total tonnage destroyed.

A small incinerator is located on Center Island which operates only from the early part of May until October. It consists of one burning unit operated under natural draft which destroys all garbage, rubbish, and night soil collected upon the islands. Last year it destroyed 656 tons at a cost per ton of $1.15 for labor, or a total cost of $1.56.

The department is confronted with the problem of disposing of about 500,000 cu. yds. annually of ashes, street sweepings, basin cleanings and incombustible material, which heretofore has been deposited in ravines and low-lying lands at a low cost and within reasonable haul from points of collection. These dumping possibilities, however, are rapidly diminishing and with few exceptions all dumps are now confined to the outlying districts and the water front. There still remain many ravines and hollows within city limits that could be utilized if it were not for the popular idea that it reduces the value of the surrounding property, while as a matter of fact the opposite is the effect. It may be necessary for the city in the near future to expropriate certain ravine lands within the city limits or obtain suitable dumping grounds beyond city limits in order to dispose of the vast quantity of incombustible material. It might be for the best interest of the city that tracts of land suitable for dumping purposes for several years to come be purchased by the city and, after they have been filled and leveled off, either devoted to municipal purposes or sold for private developments. Only in this way can the city be assured of adequate dumping space at suitable locations.



WELLINGTON DESTRUCTOR.

FOUR-YARD ROLLER-TYPE DUMP WAGON.

EQUIPMENT

The department maintains 385 horses. In construction of stables for these the department has adhered to the policy of buildings with 30 to 40 stalls each, not only from the viewpoint of fire hazards but as a sanitary measure, because it reduces to a minimum the spread of disease in the event of an epidemic. The average life of a horse in the service of the department is 6½ years. It is therefore necessary to purchase 50 to 60 animals each year to maintain the standard. In 1926 the cost of horses purchased averaged $223 each.

The department has in operation 22 motor trucks of various capacities. The 5-ton trucks may be converted from pick-up trucks to flushers or vice versa. Provisions has been made for the purchase this year of ten additional trucks for the refuse collection service.

The department has experimented with various fillings for brooms from fine steel wire to coarse cane, and has now adopted three standard brooms: A 16-inch coarse bass fibre, a 16-inch coarse bass fibre and cane, and a 24-inch fine bass fibre. The different types are used according to the surface of the roadway. In the construction of brooms, the holes are drilled at an angle so as to give a flare to the filling. There are four rows of 8 inch fibre. In the combination bass and cane broom, the cane occupies the two central rows. Refilling is undertaken as the fibre wears out. In doing this the broom heads are heated in a steam bath, the short fibre is then removed and replaced with new fibre.

Toledo Incinerators

Two sites for incinerator plants for burning garbage and combustible refuse have been selected by the public service director and city council of Toledo, O.; one just outside the eastern city limits, the other in the stockyard district of West Toledo. The former contains 11½ acres and will cost $10,600; the latter 12.66 acres at $1,500 per acre. Another site is to be purchased in the south end of the city.

Council has appropriated $100,000 to construct buildings to house the two incinerators and $133,700 for constructing two 100-ton incinerators.

Public Water Supplies in Colorado

More than half are from surface sources. Soft water for wash day only at Aspen. Three towns have dual water supplies.

By Dana E. Kepner*

A description of the public water supplies in Colorado is interesting because of the ingenious ways in which the cities and towns have utilized the unique and varied natural resources in the state, and because of the excellent methods developed for artificially treating certain unsatisfactory waters. A study of them is important because of the direct relation betwen domestic water supply and public health.

From the best available records, the first public water supply in Colorado was that of the Denver City Water Company, constructed in 1870. In 1880, nine municipalities in the state had public water supplies. Today there are 194 public supplies in the incorporated cities and towns, 179 of which are municipally owned and 15 privately owned. There are also 6 large privately owned supplies furnishing water to unincorporated communities; and probably 100 small public supplies, privately or mutually owned, at villages, resorts, camps and industrial establishments.

In the early development of public water supplies, simplicity and low cost were the principal factors. Water works engineers developed public supplies from the most convenient streams or springs in the mountains, or from the most easily constructed wells on the plains, with little regard for the quality of the water. Of late, however, the consumers' demand for satisfaction has been of growing importance. Satisfaction, when applied to domestic water supplies, is a comprehensive term. It does not imply that the water be chemically pure, but that it be safe for drinking and culinary use, palatable, and both harmless and economical for boiler and laundry use; hence, that it be free from foreign substances in objectionable amounts. Water contaminated with domestic sewage is now being filtered and sterilized to remove and kill the germs of typhoid fever and other water borne diseases; water stored in reservoirs is being aerated and chlorinated to remove unpleasant tastes and odors; and water from limestone regions is being softened to make use for boiler and laundry purposes more economical. Satisfaction also refers to the reliability of the supply; it should be capable of furnishing safe and otherwise satisfactory water in adequate quantities at all times.

The more important public water supplies in Colorado include the 194 municipal supplies and the 6 large supplies in unincorporated places. The 105th meridian, which crosses the state from north to south within a few miles of the western boundaries of Weld, Adams, Denver, Arapahoe, El Paso and Pueblo Counties, divides the state into a western, mountainous section, and an eastern, plains section. The water supplies west of this meridian, and those a few miles east of it, are largely from surface sources, while those materially east of it are from ground sources. A few combined sources are found in both sections.

Of the 200 supplies, 105 are obtained from surface sources, 80 from ground sources and 15 from combined sources. All of the surface supplies are from streams or rivers. Of the ground supplies, 37 are from deep wells, 30 from shallow wells and 13 from springs. The water of 33 surface supplies receives natural treatment, 26 by means of storage and 7 by infiltration. Artificial treatment is provided for 23 surface supplies and 1 combined supply; and chlorination for 29 surface supplies and 1 ground supply.

Probably the simplest public water supply in Colorado is that of the town of St. Elmo, consisting of a gravity pipe line taking water directly from Chalk creek and conveying it a short distance to the town, where it is piped to the consumers without charge. The largest and most intricate supply is that of Denver. Denver's new Marston Lake filter plant, completed in 1925, has many novel features, including aerators to remove objectionable tastes and odors from the water, pulverized anthracite coal 4 feet in depth as a filtering medium to provide high efficiency in the removal of bacteria and certain micro-organisms, and compressed air apparatus to aid in washing the filters. Its capacity is 64 million gallons per day and its cost was approximately two million dollars.

Three towns in the state have dual water supplies with separate sources and distribution systems. Fowler and Ordway both purchase soft, palatable, spring water from a privately owned water supply company and distribute it to their inhabitants for drinking and culinary uses only, and Sugar City obtains water for drinking and culinary uses from its own deep well, distributing it to public hydrants over the town. In addition, each of these towns has a municipally owned supply from which less attractive water is obtained and a separate system of pipes through which it is distributed to the inhabitants, for sanitation, irrigation and fire protection uses.

At Monte Vista, a city of 3000 population, an unusual situation exists. There is no public water supply system, yet there is a complete system of sanitary sewers. Practically every residence and business building in the city has its own free flowing artesian well, which operates a hydraulic ram forcing the water into an elevated tank, and from this tank the water is piped to the plumbing fixtures of the building.

The hardness of the public water supplies in Colorado varies greatly, probably more than in any other state. The softest are those of Colorado

*Sanitary Engineer, Colorado State Board of Health.

Public Water Supplies in Colorado Having Artificial Treatment of Chlorination

Supply	Source	Treatment
Berthoud	Thompson River	Mechanical filtration.
Broadmoor W. System.	N. & S. Cheyenne Cr.	*Chlorination.
Brookside W. Co.	N. Cheyenne Cr.	*Chlorination.
Canon City	Arkansas River	Coagulation, settling, filtration and chlorination.
Colorado Springs	Nine streams on Pikes Peak	*Chlorination, with storage for part of the water.
Denver	S. Platte River	Mechanical filtration and chlorination.
	Bear Creek	Mechanical filtration and chlorination.
	S. Platte River	Slow sand filtration and chlorination.
	Cherry Creek	Infiltration and *chlorination.
	*S. Platte River	Infiltration and chlorination.
Florence	3 streams and Tucker Springs	Storage, aeration and pressure filteration.
Ft. Collins	Poudre River	Mechanical filtration and chlorination.
Fountain	Little Fountain Cr.	Settling and *chlorination.
Grand Junction	Kannah Creek	*Chlorination.
Greeley	Poudre River	Slow sand filtration.
Gunnison	Gunnison River	Infiltration and chlorination.
Hayden	Bear River	Pressure filtration.
Johnstown	Thompson River	Settling, slow sand filtration (uncontrolled), and chlorination.
La Junta	Shallow Wells	Chlorination.
Littleton	S. Platte River	Infiltration and **chlorination.
Longmont	N. St. Vrain River	*Chlorination.
Loveland	Thompson River	Mechanical filtration and chlorination.
Mead	St. Vrain River	Mechanical filtration.
Montrose	*Cimarron River	Storage and *chlorination.
	*Gunnison River	Settling and chlorination.
Morrison	Bear Creek	Slow sand filtration (uncontrolled).
Oak Creek	Oak Creek	Mechanical filtration and chlorination.
Portland	Arkansas River	Mechanical filtration and chlorination.
Pueblo	Arkansas River	*Coagulation, settling and chlorination.
Rocky Ford	Arkansas River	Softening, mechanical filtration and chlorination.
Walsenburg	Cuchara Creek	Storage and chlorination.
Aurora	Denver supply	See Denver.
Edgewater	Denver supply	See Denver.
Englewood	Denver supply	See Denver.
Mountain View	Denver supply	See Denver.
South Canon	Canon City supply	See Canon City.
East Canon	Canon City supply	See Canon City.
Prospect Heights	Canon City supply	See Canon City.
Timmath	Greeley supply	See Greeley
Windsor	Greeley supply	See Greeley

*Used for a part of the year only.
**Using hypochlorite; all other chlorination with liquid chlorine.

Springs and Boulder, each having an average hardness of about 25 parts per million, while the hardest is probably that of La Junta, with a hardness at times as high as 900 parts per million. At Aspen the public supply is taken from three streams, two of which furnish a large quantity of hard water and the other a small quantity of soft water. The soft water is collected in a reservoir throughout the week and turned into the distribution system on Mondays, to make "wash day" more pleasant and economical. The only public supply in which the water is softened is that of Rocky Ford.

From a public health standpoint, the water supplies of Colorado present a problem of great importance. Many supplies obtained from mountain streams were relatively safe when installed, but with the increased use of the mountain playgrounds by campers, tourists, sportsmen and others, the watersheds have become subject to contamination to a considerable extent. Some supplies were improperly constructed in the first place and have sanitary defects liable at any time to permit contaminated water to reach the consumers. Through its Division of Sanitary Engineering, the Colorado State Board of Health is cooperating with the cities, towns and private water companies in an endeavor to prevent the undue contamination of the streams and to correct any sanitary defects in the public water supplies, thus safeguarding the people against epidemics of typhoid fever. In this connection an approval service is provided by the State Board of Health through which public water supplies, found by sanitation surveys and laboratory examinations to conform to the U. S. Treasury Department Drinking Water Standards, are approved and the municipalities permitted to place standard signs to that effect on the highways entering them. During 1926, public water supplies were thus approved at Canon City, Durango, Evans, Granada, Hudson, La Junta, Montrose, Rocky Ford, Salida, Sedgwick and Swink.

Tadpoles in Reservoirs

An experience with tadpoles in a reservoir was described as follows by J. H. Sweeney, chief engineer of water works of Wilmington, N. C., at the sixth annual meeting of the North Carolina Section of the American Water Works Association.

In the city of Wilmington we have an open reservoir. Last summer I noticed an accumulation of tadpoles and how to get rid of them was a question. I was talking to an old fisherman who hangs out at our place occasionally and he told me to get some trout and put them in the reservoir. I got the trout and put them in and in less than one week's time you would never know there was a tadpole in the reservoir. We never have any algae growth in our basins at all because we draw out every day about five or six feet and at night when the peak load is off, we fill

it up again. We still keep those fish and they look every day for nourishment. If anyone is bothered with tadpoles or algae growth, I would suggest they use trout as these trout will clean the place right up. They are good housekeepers.

Repaving Over Trenches

The procedure employed for paving over backfilled trenches in Wilmington, N. C. was discussed as follows by McKean Maffitt, superintendent of water works of that city, before the North Carolina Section of the American Water Works Association:

In patching paved streets where there is a dense traffic and it would be inconvenient to leave the hole blocked off for some time while the concrete set up, I tried the following method: Tamp the hole until it is solid as you can make it. Make a mixture of concrete the same as usual only not so wet. Make it the consistency of stiff putty. Put this in the hole and tamp it hard. I mean hard, not just light taps. Tamp it until it is almost impossible to make an impression on it with the tamping iron. Put your top surface down on this tamped concrete. Bricks, sheet asphalt, Hastings asphalt blocks, Kentucky Rock asphalt or any other kind of surfacing. Cover the finished surface with about one inch of loose sand and open it to traffic. Nothing short of a ten ton load will affect it. There are about fifty such places here in Wilmington. It worked out so well that even on those streets where there is very little traffic we do the same thing. We never block off a paved street for the regulation ten days. Only just so long as it takes us to put in the material.

Expenditures of Cities for Health, Sanitation and Charities

A summary of the expenditures for health, sanitation and charities in cities having a population of over 30,000 for the fiscal year 1925, has been issued by the Department of Commerce. The number of cities summarized was 247 and the total estimated population represented 35.3 per cent. of the entire population of the continental United States.

The costs for maintaining and operating the departments for the conservation of health, for sanitation or promotion of cleanliness, and for charities, general hospitals and insane institutions in these cities amounted to $226,337,000. This is equivalent to a per capita of $5.56 and represented 14.8 per cent. of the expenditures of all general departments for 247 cities in 1925 as compared with a per capita of $2.90, representing 15.6 per cent. of the expenditures of all general departments for 204 cities in 1915. The general departments, as the term is here used, do not include public service enterprises, such as waterworks, electric light plants, or similar public service utilities; and the costs do not include the payments for outlays for improvements, nor the interest on bonds issued for construction and equipment of these departments.

In 146 cities having more than 30,000 population in 1925 and also in 1915, the increase in the costs of operation and maintenance was 151.8 per cent. for health and sanitation, and 121.6 per cent. for charities and hospitals, including correctional institutions. This is not so great as the increase in cost of schools, which was 209.4 per cent.

For 1925 in the 247 cities the payments on account of outlays for permanent improvements for health and sanitation amounted to $119,577,000 of which $106,830,000 was for the construction of sewers. For charities and hospitals the outlays amounted to $16,510,000.

Almost without exception the per capita payments for the larger cities exceed those for the smaller ones. For cities in Group 1 (500,000 population and over) the per capita payments in 1925 for health were $1.06; for sanitation, $3.77, and for charities and hospitals, $2.43; in Group II (with a population of 300,000 to 500,000), the per capita payments for health were $1.27; for sanitation, $2.90, and $2.63 for charities and hospitals; in Group III (with a population of 100,000 to 300,000) the per capita payments were $0.77 for health; for sanitation, $1.97, and $1.02 for charities and hospitals; in Group IV (with a population of 50,000 to 100,000) the per capita payments were $0.59 for health; $2.06 for sanitation, and $0.95 for charities and hospitals; in Group V, (with a population of 30,000 to 50,000) the per capita payments for health were $0.58; sanitation, $1.66, and for charities and hospitals, $0.95.

Activated Sludge in England

Experiences of managers of a number of English plants. Causes of unsatisfactory operation. Preliminary sedimentation. Abundant aeration.

The operation of activated sludge plants was made the subject for discussion at a meeting of the Association of Managers of Sewage Disposal Works of England, held on March 12. It was an experience meeting at which the managers of several plants gave results and conclusions from actual operation of their plants.

The subject was introduced by Dr. H. T. Calvert, of the Ministry of Health and president of the association. He summed up his conclusions from inspection of practically all of the activated sludge plants in the country in the following words:

If an activated sludge plant has once been brought into successful operation the fact that something is going wrong is indicated either by a falling off in the character of the effluent or by some difficulty experienced with the disposal of the surplus sludge. It is, then, up to the manager to seek the cause of the trouble, and he may look for this in one or more of the following directions:

1. Some abnormality in the character of the sewage reaching the works.

2. In some constructional feature of the plant itself, such as:

(*a*) Locations in the aeration tanks which permit of sludge settlements in positions where it can go bad and thus inoculate the tank contents.

(*b*) Similar conditions in the settlement tank.

(*c*) Insufficient care in the construction of sludge drying beds so that these become rapidly clogged with sludge, and have then to rely entirely upon evaporation for the dewatering of the sludge.

3. Some factor in the method of working the plant such as;

(*a*) Inadequate velocity of flow in the aeration channels, thus permitting settlement of the sludge, which becomes bad.

(*b*) Non-removal of sludge from the settlement tanks, thus permitting it to become bad, and

(c) Inadequate aeration, over aeration, excessive mixing, or some other abstruse factor in the aeration tank which puts the sludge into such a state that it will neither settle in the settlement tanks nor readily drain on properly constructed sludge drying beds.

As regards the character of the sewage which reaches the works, I do not think that much trouble is to be anticipated from variations in the rate of flow due to wet weather conditions unless it be that the first flush of the storm washes out septic deposits from sewers of poor gradient. More trouble is, however, to be expected from abnormal rushes of certain kinds of trade refuse, more especially of spent gas liquor.

With regard to constructional details, these should be designed in such a way that whatever process is used it is possible to maintain aerobic conditions as high as possible in every portion of the aeration tank and to prevent anaerobic conditions prevailing in the settlement tank.

To ensure these conditions careful attention has to be given to the velocity of flow in the aeration tanks and to the rate of removal of activated sludge from the settlement tanks.

Most of the superintendents believed that it is desirable to pass the sewage through preliminary tanks before it reaches the activated sludge tank. This was partly to relieve the sewage of the suspended solids, which could be disposed of in this way more economically than by treating in the activated sludge plant; and partly in order to secure a more or less complete averaging of the flow and thus saving the activated sludge plant from the occasional sudden inflow of sewage of high degree of impurity, especially those contributed by commercial wastes. In one case the problem of commercial waste was solved with apparent satisfaction by chemical precipitation. If there is no preliminary tank treatment, and because the greater volume of sewage generally coincides with maximum strength of sewage, the plant must be so designed that its aeration capacity will be sufficient to insure proper aeration of the maximum quantities of flow during maximum strength. Captain Speight, of Bolton, has provided a balancing tank into which he draws off and stores part of the strong day sewage, say that between the hours of 8 a.m. and 6 p.m., and returns this to the flow during the night when both volume and strength of sewage are at a minimum. According to H. C. Whitehead, Birmingham, until the production of dried activated sludge was a commercial possibility, thorough preliminary sedimentation appeared to be a wise precaution, and one which in the case of strong sewages was a necessity, the simple reason being that an excess of activated sludge-forming material unnecessarily increased the oxygen demand in the plant.

Captain Speight has come to the conclusion that in order to maintain sludge in an active condition much longer periods of aeration are necessary than was originally considered. Six or eight hours is not sufficient, but something like 16 or 18 hours is necessary for a complete process, or else a shorter detention period with a longer period of re-aeration of sludge. Also, it was at first thought necessary to keep 25 per cent. to 30 per cent. of sludge in circulation, but the later tendency is to keep this percentage down to about 10 per cent. The more sludge one keeps in circulation, the more air is required for maintaining it in an active condition and consequently the less is available for the oxidation of the sewage. This resulted in sludge bulking and bad settlement.

The matter of bulking of sludge has apparently troubled most of the superintendents. Joshua Bolton, of Bury, said that while bulking had been attributed in some cases to under-aeration and in others to over-aeration, he was coming firmly to the conclusion that it is due to certain characteristics and constituents in the sewage. J. Haworth, of Sheffield, found that bulking occurred more often when they were carrying too much sludge than when too little, there having been no bulking for twelve months in a tank running with about 12 per cent of sludge.

H. C. Whitehead, engineer to the Birmingham Drainage Board, stated that the principal variable factor in the design of an activated sludge plant is the provision for aeration, and if, as many think, the bulk of oxygen taken up during the process is absorbed at the broken surface, it follows that a greater area of broken surface is required for a strong sewage than for a weak one. If this is so, and he believed it to be a fact, there is a very important relation between the strength of sewage and the depth of aeration tanks. Also, he believed it to be very important to be able to readily increase aeration without materially increasing the power consumed by mixing. It is often necessary in warm weather to increase the amount of oxygen put into the sewage and in most plants this can only be done in an extravagant manner by increasing the mixing intensity at the same time.

This seems to offer an argument for mechanical mixing, and A. E. Loach, of Wakefield, gave some facts concerning the mechanical mixing plant of that city, which installed mechanical and electrical equipment to a value of over $60,000. Repairs to this plant during nearly three years have amounted to only 34 shillings, no difficulties have been experienced in operating the plant, the reduction gears and motors for paddle driving had run 24,000 hours almost continuously, 2,000 and even 3,000 hours non-stop runs having been made, without any mechanical defect or repairs. Incidentally, he preferred slip ring motors for driving paddles, as to start up the paddles in still water would place a very heavy temporary overload on a squirrel-cage motor. As to the power required, one horsepower was used for circulation of 10,000 gallons at one plant and for 22,500 gallons in another plant, the velocity being 1½ feet per second in each. In this kind of plant a most important feature was the maintaining of absolutely continuous driving of the paddle shaft.

Some of the superintendents have found difficulty owing to septic sludge forming in the tank, one even claiming that over-aerated sludge became septic.

Mr. Bolton did not think that highly skilled superintendents were necessary for these plants, as at first had been maintained. Given a liberal detention period, say 12 to 16 hours in dry weather, and a power consumption, including sludge return, of about 25 horse-power per million gallons, and good results were pretty certain.

He referred to difficulties experienced with gas liquor in the sewage (which was referred to by others also), but stated that if it could be run into the sewers at a uniform rate rather than in infrequent large doses, the plant would adjust itself to the continuous presence of that small amount. So true is this, that a plant which had so adjusted itself would show a temporary falling off in quality of effluent if the gas liquor ceased to flow into the sewage. A similar idea was expressed by others, namely that uniformity in quality of sewage was of the greatest advantage in activated sludge plants. One manager suggested running the sewage through a number of sedimentation tanks in parallel, the tanks having different capacities and therefore discharging into the effluent channel sewages received at different times, the tendency being therefore to produce a more uniform quality of sewage.

An effect of varying strength of sewage was described by H. D. Bell, manager of the Barnsley sewage works. This plant has a capacity just about equal to the average quality and quantity of flow. As a result, during the flow of strong sewage the aeration tank was unable to purify all the sewage and septic humus would result; but during the night, when the flow was less in volume and weaker in quality the aeration tank would recover somewhat. This would continue until Saturday, at which time the humus had reached a very poor condition, but recovered during the Saturday night, Sunday and Sunday night when the sewage was weaker and less in volume. During August of last year the amount of sewage was slightly increased and this was the cause of a partial breakdown of the plant, since it was not able to recover, even during week ends, from the over-loading during the day time.

Fill Settlement in Peat Marshes*

Methods adopted by Michigan State Highway Department as a result of special investigation and study—Settlement to be completed before pavement is laid.

By V. R. Burton†

Settlement of fills in peat marshes, a source of serious trouble in many places, has been the subject of special study by the Michigan State Highway Department. It was desired to ascertain the physical characteristics of the peat and decide on the field data necessary to locate properly and estimate the cost of a road over a peat deposit. It was hoped that it would be possible to devise a more economical method of construction, and to determine better maintenance methods.

In carrying out the study of fill settlement, it was decided to cross-section marshes accurately by borings showing the exact location of the various peat layers and of the filled material with reference to them. Fills over eight different peat deposits were cross-sectioned at 83 different points where the depth of peat ranged from 1 to 66 feet. The shape of the fill material was determined accurately, and an effort made to extend the zone of the cross section sufficiently to reach beyond the area of disturbance caused by the fill.

All fills investigated were of earth. The various factors which it was thought should determine the amount of settlement were depth and character of peat layering, height of water table, slope of subsoil beneath the peat, and height and width of fill.

While other factors have an influence, those of greatest importance were found to be the depth of the peat layer and the depth of the lake clay beneath it. The height of the fill above the marsh surface is, of course, a factor, but not so great a one as might be expected. In peat depths of less than 10 feet, the effect is small; from 10 to 25 feet, the height of fill produces a considerable effect; in depths greater than 25 feet it is not important. The slope of the peat subsoil and the proximity of neighboring fills are of importance.

Early settlement of fills is comparatively rapid, while in later stages it is slow; but even a foot a year is decidedly objectionable. The length of time required to reach a stable condition is, in some cases, as much as five years. It is important that settlement be practically complete before any rigid surfacing is laid, since the only remedy for considerable settlement of a hard-surface highway is refilling and resurfacing.

A number of cross-sections illustrating various shapes taken by fills are shown in the accompanying figures.

From the whole series of cross-sections taken, diagrams giving the amount of settlement and shape of fill have been prepared. Depths of peat and marl on the center line of the fill were platted,

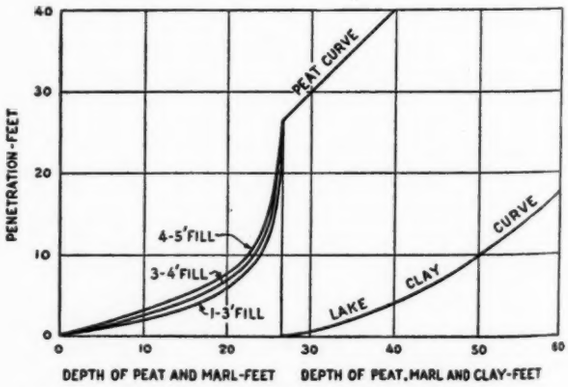


FIG. 7.—DIAGRAM GIVING PROBABLE DEPTH OF PENETRATION OF FILLS IN PEAT MARSHES.

*Abstract of paper presented at fifth annual meeting of Highway Research Council.

†Engineer on Special Assignments, Michigan State Highway Department.

against the total depth to which the fill penetrated, as measured from the original marsh surface. Three curves were then drawn, one representing the average of fills with a height above marsh level of 1 to 3 feet, one for heights of 3 to 4 feet, and one for heights of 4 to 5 feet. These three curves, shown in Fig. 7, indicate that the amount of settlement increases uniformly, but is not great up to a marsh depth of about 20 feet. As the marsh depth increases from 20 to 26.5 feet, the settlement increases rapidly, and when the depth exceeds 26.5 feet, the fill goes completely through the peat in every instance, so that the penetration is equal to the depth. Therefore, for peat and marl depths

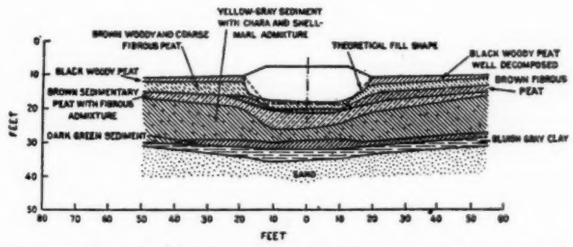


FIG. 1.—FILL OF NORMAL CROSS SECTION IN A PEAT MARSH ABOUT 22 FEET DEEP FROM SURFACE TO CLAY

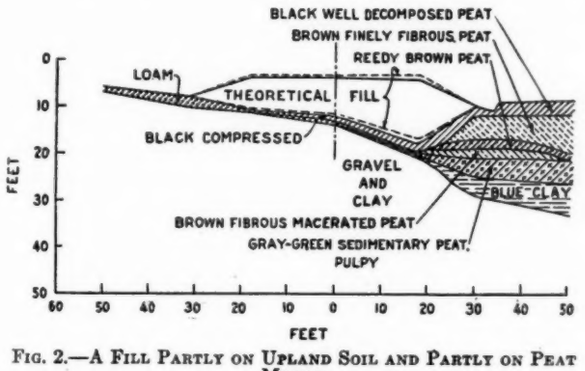


FIG. 2.—A FILL PARTLY ON UPLAND SOIL AND PARTLY ON PEAT MARSH

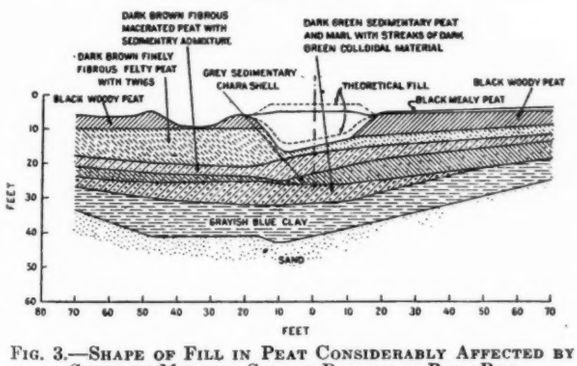


FIG. 3.—SHAPE OF FILL IN PEAT CONSIDERABLY AFFECTED BY SLOPE OF MINERAL SOIL AT BOTTOM OF PEAT BED

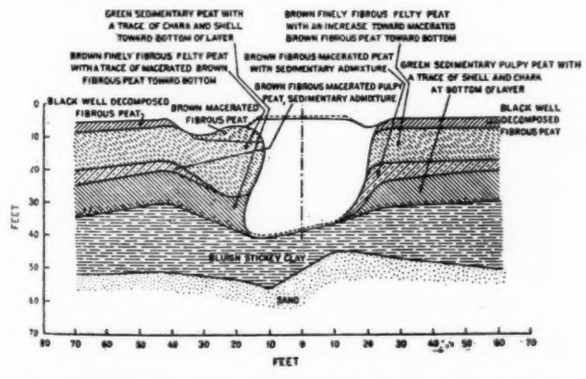
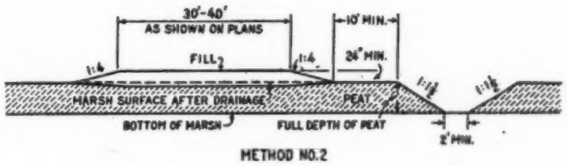
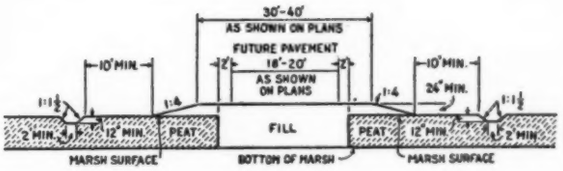


FIG. 4.—DISTORTION OF PEAT FILL TO THE LEFT DUE TO SLOPE OF FIRM SOIL BENEATH PEAT BED.

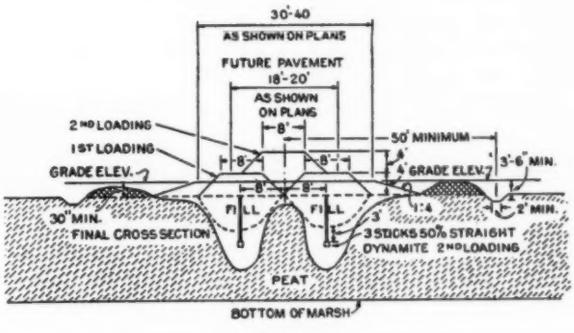
METHOD NO. 1



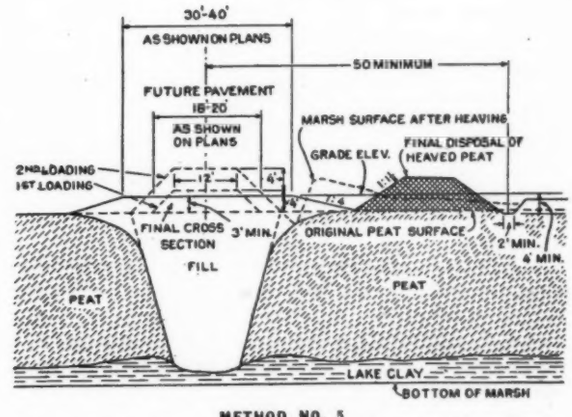
METHOD NO. 2



METHOD NO. 3



METHOD NO. 4



METHOD NO. 5

FIGS. 9 AND 10.—STANDARD METHODS OF MICHIGAN STATE HIGHWAY DEPARTMENT FOR FILLING OVER PEAT BOGS.

of less than 26.5 feet, the depth of clay underneath need not be taken into account, except as a factor in case settlement should not follow the average, and the anticipated settlement may be read directly from the diagram. For depths of peat and marl over 26.5 feet, settlement will probably be the full depth of the deposit plus some penetration into the lake clay. The amount of penetration into the lake clay is read directly from the curve in Fig. 7.

The curves given are purely empirical, and represent merely the average behavior of a considerable number of fills. Extreme variations of actual from expected settlements have been found to be as much as 100 per cent for an indicated settlement of 5 feet, 60 per cent for 10 feet, 30 per cent for 20 feet, 20 per cent for 25 feet, 10 per cent for 30 feet and less for greater amounts.

In places where there is any considerable depth of peat, it is highly important that settlement during filling be expedited in every possible way, since it must be practically complete before any rigid surfacing is placed.

STANDARD METHODS

Figs. 9 and 10 illustrate methods of filling over peat bogs now standard with the Michigan Highway Department. Method No. 1 consists in placing the fill on the peat surface and is used where the marsh is more than 300 feet wide, less than 6 feet deep, and undrained. If settlement takes place, it will be gradual and the height of fill will usually take care of it. Method No. 2 is used under similar conditions in drained marshes. The ditch is excavated prior to making the fill. Method No. 3 is employed where even small settlement is undesirable. Peat is excavated to a width 4 feet greater than the proposed pavement slab, and the excavation filled with good earth. These methods are suitable for bogs not in excess of 6 feet deep.

Method No. 4 is used where the depth exceeds 6 but is less than 20 feet. In the first stage two narrow fills, spaced 16 feet on centers, are carried across the marsh. The supporting power of the peat crust is destroyed by blasting on the center line of each of the fills. The trenches thus made are back-filled with earth in 4-foot lifts and carried simultaneously across the marsh, thus trapping a certain amount of peat between the fills. When the first two lines of embankment have been complete, and settlement has slowed up, charges of dynamite are placed in the peat in 4-foot centers, 2 or 3 feet underneath the two lines of fill, and exploded. This drives the peat from beneath the wedges of earth, and induces rapid settlement. After refilling the settlement caused by the shooting, filling is continued on the centerline. The loading is maintained until the rate of settlement is less than 0.05 feet in 30 days. The excess earth is then spread to form the complete embankment.

Bogs from 6 to 20 feet in depth usually give more trouble than any others, because they rarely settle rapidly unless excessively loaded, and surfaces are laid on fills long before complete settlement has been attained. For depths over 20 feet, the center loading is used at once after the surface of the peat has been broken up by dynamite. A fill 12 feet wide and 4 feet high is maintained at grade as nearly as possible until it reaches entirely across the space over which this method is to be used. As soon as it can be maintained at grade, a second 4-foot lift is added. After settlement following this lift has slowed down to the rate of 0.05 feet in 30 days, the fill is unloaded and the excess material spread to form the cross-section. This is shown as Method No. 5, Fig. 10.

Where bridges are to be placed over streams through deep peat deposits, approaches should always be completed first. Filling should continue toward the center of the stream so that excavations for footings will occur in the filled earth. In some cases where the streams are small, it will be found advisable to carry the filling completely across the old stream bed. The expense of cleaning out the earth above stream bottom and taking care of the stream flow during filling is money well spent.

When a bridge rests on piling with lengths of over 10 feet penetrating soft peat before hard bottom is reached, the bending stresses induced in the piling during backfilling may cause failure, where sufficient penetration is obtained to give good anchorage to the piles. If pile penetration is limited, the bottom of the piles may slide. If the deposit is deep, the piling may be flexible enough so that it acts as a cantilever fixed at the bottom, and the whole structure may be moved in one direction. The forces due to the compression and flow of peat have been the cause of a number of bridge failures.

In one case in Michigan in 1916, a 40-foot bridge was put in, supported by a 50-foot spliced piling. Some time after filling of the approach had been started the bridge began to move, slid along the axis of the roadway and inside of a week had completely disappeared from sight. In another case in a peat deposit about 40 feet deep, a 40-foot bridge rotated about 5° about one end, and settlement then began in sufficient amount to destroy the bridge. Had the approach fills been made first, these failures would not have occurred.

The maintenance of a road surface which is settling is a difficult matter to handle. In a number of cases where the amount of settlement was not over a foot or two and a concrete surface had been placed, the slabs have been jacked back to grade and the space beneath the slab refilled with tamped earth. It is for this reason that mesh reinforcement is desirable, as it has been found that reinforced slabs can be jacked back into place with very much less breakage than the plain slab. In other cases, where the settlement has been accompanied by considerable slab breakage, it has been necessary to remove the surface, bring the fill back to grade, and replace the surface. Where the amount of settlement is considerable it may be possible to effect a remedy by removing only a part of the pavement at each end of the settlement and placing new sections which will join the sunken slab properly to the surface adjacent to the settlement.

It is unfortunate that the present methods of filling have been used for so short a time, as it is impossible accurately to estimate the amount of filling material necessary with methods 4 and 5. Quantities in each case will be less than those indicated by curves derived from an investigation of fills which have been placed full width on the surface of the undisturbed peat. It is planned, as soon as a sufficient number of these examples are available, to cross section and determine the amount

necessary, using the new method. We are confident that the methods proposed will eliminate a great deal of the settlement formerly encountered, and will involve the use of smaller amounts of material in filling.

California Engineer's Invention for Cross-Sectioning*

By Fred J. Grumm†

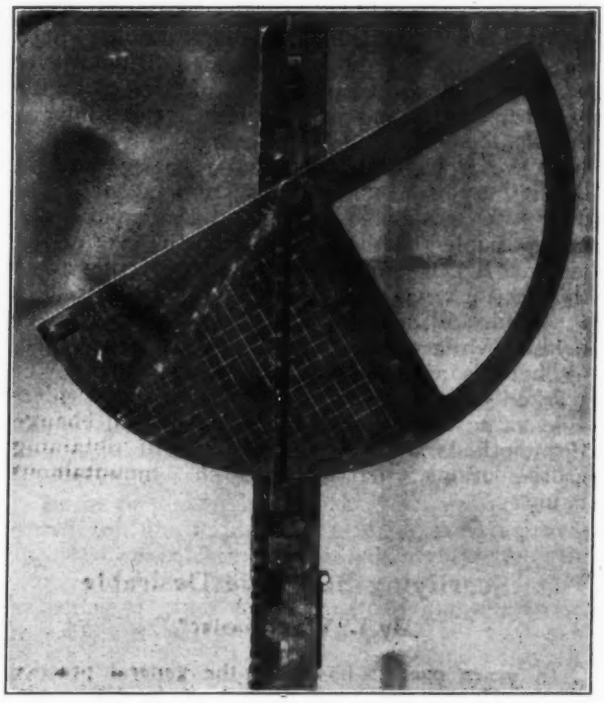
Surveying instruments such as the transit and level, except for minor improvements have, in many years, changed but slightly in form and principle. The methods, too, of obtaining information in the field form a well established procedure. As a result the rate of progress of a survey party is largely dependent on the ability and application of its personnel. To develop a device or instrument, therefore, which will effect a saving in time and consequently in the expense of surveys should be considered a meritorious accomplishment.

W. T. Rhodes, resident engineer on the Yosemite road, Briceburg to El Portal, has invented a device for cross-sectioning and slope-staking which has proved effective in saving both time and labor. It consists of a simple arrangement of scales on a staff or rod, combined in such a manner that distances, vertically and horizontally, to a point are readily obtained graphically when the slope distance is found by measurement.

Horizontal and vertical distances, representing the base and altitude of a right-angled triangle, are read from scales founded on a movable arc revolving about a center of definite height. The slope distance, which is the hypotenuse, is found on the fixed vertical scale. Revolving the arc and sighting the point on which the elevation is desired determines the vertical angle.

The operation of taking cross-sections consists of setting the instrument on a station or point whose elevation is known. It is plumbed by means of a rod level attached to the staff and steadied in this position by one man who also holds the tape. The observer sights on the point or rod held by the rodman, who holds the zero end of the tape. The arc is clamped in position and the slope measurement taken with the tape. Applying the slope measurement to the fixed scale, the observer then reads the vertical and horizontal distances directly from the respective scales on the arc.

The device can be used equally well for original or final cross-sections, setting slope stakes, reference points from center line, or reestablishing the center line from reference points. A three-man party can efficiently handle the work in mountainous and rugged country. Where work is light and the progress of cross-sectioning more rapid, the addition of a note recorder is an advantage. Setting of slope stakes in light work is also expedited by the addition of a man to handle the stakes.



CLOSE UP OF CROSS-SECTIONING DEVICE.

The instrument replaces the transit in the method of taking cross-sections by slope angles and slope measurements. Weighing less than ten pounds, it has the advantage of being lighter and more portable; it can be instantly set up. The device eliminates troublesome manipulations, determines elevation and horizontal distances with mathematical calculations, thus reducing possibilities of error. Its simplicity of design eliminates expensive repairs, and its operation does not require an instrument man with years of experience.

It is estimated by those who have used it, that the work of taking original cross-sections in rough country can be accomplished in one-half the time required by other accurate methods. It is obvious that in level country where

USING CROSS-SECTIONING DEVICE IN SURVEYING THE MERCED-YOSEMITE HIGHWAY.

*From "California Highways."
†Engineer of Surveys and Plans, California Highway Department.

side shots are within the limits of the level set up, the time saving is not so great, but where side shots must be obtained by use of hand level or slope angles, the elimination of the possibility of error and saving in time is a decided advantage.

In the work of taking final cross-sections in Kern Canyon, a nine-mile section, a saving of over $300 was made because of the rapid progress possible and the reduction in the size of the party. Because of the simplicity of the notes the sections were easily and rapidly plotted in the field, and, as a result, the party was never held up while waiting for sections to be checked.

There is a reason to believe that the device worked out by Mr. Rhodes will be of considerable value to engineers and that it will change the methods and lessen the cost of obtaining cross-sections, particularly in mountainous country.

Scarifying Subgrade Desirable

By L. W. Roessler*

In years past it has been the general practice among Engineers to include a clause in their specifications forbidding the contractor, in excavating for his base or completed pavement, to plow or stir up the earth below the finished subgrade. Due to unequal traffic on the unpaved street or highway, prior to paving, some portions are thoroughly compacted, while others are soft and mellow. This uneven compactness of the subgrade cannot be made uniform by rolling, consequently after your base supporting a wearing surface, or a one course concrete paving is laid, the action of the elements on the thoroughly compacted soil differs from that on the less compacted soil, causing a heaving of the base or paving.

The above condition is particularly true on flat grades in cities where, in the preparation of the subgrade, it is only necessary to remove the top soil to a depth of from 3 to 10 inches and in some instances where the streets have been filled year after year with cinders and brick-bats, just reaching the original traveled roadbed with the subgrade for your paving.

The past three years I have included in my specifications a clause requiring the contractor, after the rough grading has been done, to scarify the entire roadway to a depth of three inches, the same to be done uniformly by means of a scarifier, after which the roadway shall be rolled.

I also specify that light trucks shall be used for delivering materials for the paving on the street, and in going to and from the point where material is deposited on the subgrade the trucks shall not follow in one track but shall travel as uniformly as possible the entire surface of the street to be paved.

This method gives a more uniform subgrade with the result that fewer cracks occur and there is less heaving at the joints.

* City Engineer, Fremont, Neb.

A Billion for Roads in 1927

The construction of 26,841 miles of road and the maintenance of 239,847 miles are included in the 1927 state highway programs of forty-seven states, according to the Bureau of Public Roads, United States Department of Agriculture. The programs also include the construction of a number of large bridges and the reconstruction of roads previously improved. On account of uncertainty of supporting legislation no estimate of the season's work is possible as yet in Connecticut.

In carrying out the above programs it is expected there will be expended under the supervision of the state highway departments in the forty-seven states a total of $648,483,000.

In addition to the state expenditures, estimates indicate that counties and other lesser subdivisions of government will expend during the year $475,000,000.

Of the expenditures by the state highway departments of the forty-seven states approximately $421,000,000 is the estimated amount for road construction and, according to present plans, more than $56,000,000 additional will be spent for new bridges. For reconstruction of existing roads it is estimated that the expenditure will be nearly $27,000,000, and for maintenance approximately $126,000,000.

The mileage of new state highway construction contemplated during the year, subdivided by classes of surface, is given below:

Estimated road mileage to be built by state highway departments:

States.	Earth improved.	Sandclay gravel and macadam.	Asphalt concrete and brick.	Total mileage.
Alabama	67	279	60	406
Arizona	30	67	3	100
Arkansas	250	300	30	580
California	—	65	15	80
Colorado	32	49	43	124
Delaware	—	15	60	75
Florida	275	100	400	775
Georgia	100	250	156	506
Idaho	25	105	15	145
Illinois	219	—	1,036	1,255
Indiana	40	100	275	415
Iowa	308	519	263	1,090
Kansas	836	522	240	1,598
Kentucky	400	330	170	900
Louisiana	—	450	50	500
Maine	—	359	55	414
Maryland	—	35	89	124
Massachusetts	—	50	190	240
Michigan	50	165	200	415
Minnesota	490	390	127	1,007
Mississippi	231	238	55	524
Missouri	450	350	122	922
Montana	—	250	1	251
Nebraska	600	700	10	1,310
Nevada	—	145	4	149
New Hampshire	10	75	15	100
New Jersey	10	—	110	120
New Mexico	45	125	9	179
New York	—	—	1,006	1,006
North Carolina	—	500	150	650
North Dakota	521	521	—	1,042
Ohio	50	500	300	850
Oklahoma	300	400	150	850
Oregon	125	125	2	252
Pennsylvania	100	400	800	1,300
Rhode Island	—	—	44	44
South Carolina	—	350	250	600
South Dakota	—	450	—	450
Tennessee	223	113	193	529
Texas	600	1,000	200	1,800
Utah	—	93	7	100
Vermont	—	100	10	110
Virginia	50	100	75	225
Washington	170	165	50	385
West Virginia	200	150	75	425
Wisconsin	—	1,195	374	1,569
Wyoming	150	200	—	350
Totals	6,957	12,395	7,489	26,841

Modern Highway Traffic and the Planning of State Highway Systems*

By Dr. J. G. McKay†

The principal function of the motor vehicle as a part of a correlated system of rail, water, and highway transportation, as indicated by its present trends, seems to be its development in the short-haul zone, with great potential possibilities of volume service in terminal areas of dense population.

The present problem is one of planning, intelligently and scientifically, highway systems to serve this rapidly growing method of transportation. The development and establishment of plans which will result in the maximum of highway improvement and transportation service with the revenue available, require a careful analysis of highway traffic, the trends of its development, and its distribution over the highway systems.

The plan of state highway improvement may alter materially the economic and social development of the people as a whole, or of any section. The location and improvement, or lack of improvement, of any route is of importance not only to the traffic of the immediate locality but also to the traffic of larger areas. Planning and constructing a connected system of highways have to do with the future growth and destiny of localities, industries, and social and business activities.

Whether the highway should be built or not, and how much highway service should be furnished, is the real problem, not the question of the particular type of materials to be used, which is really secondary.

The first step in planning a program of highway improvement is the measurement of the present and the prediction of the future volume and character of traffic on the state primary, secondary and tertiary systems. The principal traffic factors involved in judging the relative importance of the three systems, or sections of each system, are the average daily and maximum total traffic, and the average daily and maximum truck traffic using each section. The average daily number of loaded light (one-half to 2½-ton), medium (3 to 4-ton), and heavy (5 to 7½-ton) vehicles is an important factor in the determination of the plan of improvement as well as in the selection of the pavement types to be constructed.

The second step is the determination of the relationship between population and demands for highway service and the consideration of present density of population and population trends as an aid in the development of a plan of improvement which will most efficiently serve the traffic needs of this population.

Classification of the various highways is the next step. These may be major routes (Class A), secondary traffic routes (Class B), or minor traffic routes (Class C). A Class A highway is one that requires a so-called rigid type of pavement; Class B requires a so-called flexible type of pavement; and Class C requires lesser types of improvements.

The fourth step is the measurement of motor vehicle mileage on the highway systems, and the estimate of earning capacity, to determine the relative vehicle-use value as a guide in developing the plan of improvement and the budgeting of construction and maintenance funds.

It is necessary finally to have a thorough analysis of the present system and the physical condition of existing improvements on it, since the plan of betterment must, in general, incorporate the existing state highway system as the basis of the improvement plan.

In the plan of a state highway system, there are two distinct phases to be considered. The first is the general state plan; the second is the special consideration necessary in areas adjacent to large centers of population. These two should be worked out co-operatively in order that traffic may be distributed, connections provided, and city streets improved.

In the final analysis, the value of a transportation survey and the resulting plan of highway improvement are probably measured quite accurately by the actual highway construction, reconstruction and widening program which is carried into effect over a number of years.

*Abstracted from Public Roads.
†Chief, Division of Highway Economics, U. S. Bureau of Public Roads.

Asphalt Concrete on Caliche Base

By George E. Franklin*

State Highway No. 83 runs east and west through Jones County, Texas, for thirty-two miles, forming part of the route from Fort Worth to New Mexico. Jones County is in the west central part of Texas and is devoted chiefly to agriculture, cattle raising and oil production. This county, like a few other localities in the south, contains a material known as Caliche gravel, which is soft when taken from the pit but has a very high cementing value and makes up into a very hard surface, impervious to water. In the construction of Highway No. 83, which was completed only a short time ago, Caliche was used for a base, being obtained from various pits alongside the road, the maximum haul being three miles and the average haul considerably less than one mile.

The road is built 16 feet wide, with a base about 8 inches thick and a wearing surface of 2 inches of asphaltic concrete. The Caliche gravel was placed

*Division Engineer, Texas State Highway Department.

PART OF HIGHWAY NO. 83, JONES COUNTY, TEXAS.

on the subgrade in one layer, 45 cu. yards being used to the station, and was rolled with a three-wheel ten-ton roller. Shoulder drains were constructed where necessary. The Caliche set up into a hard slab which was in no place less than 7 inches thick. Great care was taken to give a smooth, uniform surface to the base so as to obtain a uniform thickness of the wearing surface. In a few short stretches it was decided that it would be economical to use a close binder ahead of the surface course, and on these portions of the road from 12 to 14 tons of binder per mile were used. On the remainder of the road a standard 2 inch asphaltic concrete surface was laid directly on the base. The chief inspector was experienced in both macadam and asphaltic construction and there was strict plant inspection, a representative of a well known testing laboratory being present at the plant at all times.

The materials used were Texaco No. 54 Paving Cement, hard limestone, well graded sand, and stone dust.

An inovation in construction methods worthy of mention is that two 2,000 sq. yd. plants were set up side by side at Anson and all of the road except the eastern 8 miles was built from this set up. For these 8 miles one plant was moved to Lueders, near the end of the section, while the other plant remained at Anson completing the west end of the road.

In the 32 miles of this road there is only one bridge of any size, a 150-foot steel span over the Clear Fork of Brazos river. There are but five curves, each under six degrees. One can almost stand at one end of the road and see the other end.

As far as our records go, this is the first asphaltic concrete road laid on a Caliche gravel base. It has been completed but a short time but gives every evidence of being a first class road in every respect and we are convinced that the base will prove entirely satisfactorily.

The general contractor was the Tibbetts Construction Company of Fort Worth. The Phoenix Construction Company of Dallas constructed the asphaltic concrete surface as sub-contractor.

Dust Elimination on Michigan Highways

Measures for reduction or elimination of dust were applied to more than 2,100 miles of gravel trunk line roads in 1926 by the Michigan Highway Department. Calcium chloride was used on 2,090 miles, 14,580 tons being required, and light asphalt oil was applied to 57 miles. The use of these materials not only serve to make the roads more comfortable and safe for traffic, but keeps the gravel surface in a moist and workable condition for the operation of patrol graders. The filler in the gravel is retained in the road, instead of being blown away, effecting a saving in the amount of resurfacing necessary. The mileage of gravel roads treated with dust layer in 1926 comprise approximately one-half of the gravel road mileage on the trunk line system and there is a possibility of further extension of this work.

Another form of maintenance treatment of gravel roads used extensively in the past few years by the Department is the application of a surface treatment of tar or asphalt. This form of treatment solidifies the surface into a compact mat, eliminating dust and loose gravel. Patrol graders are not used on this form of surface, but hand patching of small breaks is carried on with a mixture of sand and bituminous material.

Concrete Cores and Thickness Tolerance

The case of Geo. W. Chambers, Claimant, v. The State of New York, Claim No. 18226, decided November 19, 1926, by the Court of Claims of the State of N. Y., is an interesting one. The suit was brought by Chambers against the state for damages suffered by him when he was compelled to tear out part of a concrete highway and reconstruct same to meet the objections of the Highway Department. The contract of Chambers involved the reconstruction of an old macadam road by building two nine ft. strips of 7" concrete separated by a six foot strip of bituminous macadam.

In making core tests of the concrete, ten cores taken out of six contiguous slabs covering a distance of 320 feet exhibited a thickness as follows:

Core No. 1	6.25 in.	Core No. 6	6.53 in.
" " 2	6.50 "	" " 7	6.7 "
" " 3	6.50 "	" " 8	6.25 "
" " 4	6.25 "	" " 9	6.38 "
" " 5	6.50 "	" " 10	6. "

Upon this showing, the highway commissioner compelled Chambers to take up these six slabs and relay them, upon the ground that they were not seven inches thick, and therefore did not comply with the specifications. Chambers complied with the orders of the highway commissioner, and while the six slabs were being taken up, a state engineer on the job made measurements of their thickness. From these measurements, taken when the concrete was being removed, it was found that the average thicknesses of the six slabs were as follows:

No. 1	7.215 in.	No. 4	6.844 in.
" 2	6.812 "	" 5	6.697 "
" 3	6.676 "	" 6	7.1 "

Sixty-six per cent of the measurements showed a thickness of from 7 inches to 8 inches.

No question was raised as to the good faith of the contractor, and there was no charge that he had any intention of ignoring any of the provisions of the contract. It did not appear anyone had any suspicion during the progress of the work that the contract was not being properly performed, and the original work proceeded to the satisfaction of the engineer in charge, and no question was raised until the cores were taken. Chambers claimed reimbursement from the state for the cost of relaying the concrete on the ground that the original work was a substantial performance of his contract. The Court sustained this claim, observed that each case of this character has to be determined on its own particular facts, and expressly declined to lay down any general rule to govern in similar cases. The Court also said that all it desired to be understood in holding was that it was not satisfied from the evidence before it that a sufficient amount of concrete was laid thinner than seven inches to enable it to find properly that the work done by the claimant was not a substantial performance of his contract.—(*Bulletin, Ohio Contractors Assn.*)

PUBLIC WORKS

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CONTENTS

County Highway Workers

For the ten years or more, *Public Works* has collected and published annually statistics of county road work. The individual returns are made by the men who have charge of road work in their respective counties. Judging from these returns, there has been a steady improvement in the quality of the personnel engaged in this work. The many hundred returns which reached this office during the past month have evidenced an unexpected degree of engineering knowledge and familiarity with latest developments in highway work.

Perhaps, after all, this is to be expected, considering the very large sums now being spent on country road work. Six counties in Alabama, none of them large or rich, show expenditures for 1926 averaging $150,000 each; six counties in Florida averaged over half a million dollars each; seven counties in New York spent an average of a million each; eleven counties in Washington spent a total of two and a quarter million. Throughout the country, the average county probably spends not far from a quarter of a million dollars a year on road work, not including township work. And there are more than three thousand counties in the forty-eight states.

With such expenditures, first class engineering supervision is a requisite, and is also an economy. Road building is one of our greatest industries, and it is pleasing to know that it is, on the whole, in able hands.

Maximum Use of Highways

Much thought is being given to the changes necessary in highway construction or traffic regulations which will enable uninterrupted use of the full road facilities even at periods of peak travel. It is recognized that there is little use in building a wide road, suitable perhaps for 6 or 8 lanes of traffic, if intersections or crossings form such dams or bottlenecks that the actual capacity is little more than that of an uninterrupted 2-lane street. Elimination of rail crossings and road intersections is a tremendous problem, in the solving of which only the first steps have been taken. More progress has been made in getting rid of sharp curves and steep grades, but a real solution of the traffic problem will probably never be attained unless some provision is made whereby an uninterrupted flow of traffic over our broad highways is obtained. Until this is done, our wider highways will not carry the amount of traffic for which they were designed.

Dust Reduces Highway Capacity

A recent report of the highway department of a western state says: "Investigations are now going on as to the possibility of removing the dust menace on these (gravel) highways so that a larger number of vehicles may travel thereon, permitting the ve-

hicles to be closer than a quarter of a mile apart and ride in comfort."

At this distance apart and traveling 30 miles an hour, a maximum of 120 vehicles per hour would use the road. This might be as many as would desire to use many of the roads.

More serious, perhaps, is the danger caused by dust, first, by obscuring the vision of drivers of automobiles when meeting or passing; and second, by the desire every driver naturally feels to pass the car ahead to escape its dust, or prevent the passing of the car behind, leading to racing in a cloud of dust that would conceal from view an approaching car.

There is also to be considered the damage to the road by the removal of surface binding material.

Traffic Engineers

While traffic regulation is generally placed in the hands of the police department, by our cities, there are a number of phases of it which can best be worked out by engineers or at least by use of engineering methods. In an address before the Engineers' Club of Philadelphia, William B. Powell named four cities which have employed engineers for this purpose.

"Pittsburgh has a traffic engineer who is attached to the Mayor's Department. Detroit has one also," said Mr. Powell. "Both of them are young men, trained in the city planning field originally, but very active in the more immediate field of the things that have to be done from day to day. In Buffalo, I am acting as consulting engineer to the chief of police under the authority of the mayor, and in Washington they have a commission which has a traffic engineer on it as an assistant. In those cities we are beginning to bring the engineering viewpoint in contact with the daily problem and we have made some little degree of progress."

Mr. Powell cited one instance where the simplest of engineering methods substituted knowledge for guess work. In Buffalo about a year ago a regulation was adopted forbidding parking or standing vehicles on the main retail street between 4:30 and 6 P. M. Soon after the secretary of the Retail Merchants' Association complained that the ruling was killing their business and that no one was now entering the stores during the hours named. Fortunately, the engineer had anticipated some such complaint and had actual figures from counts of those visiting the stores before and after the ruling went into effect, which figures showed that as a matter of fact more people had entered the stores between 4:30 and 6 P. M. after the ruling went into effect than before it.

The business men of Buffalo as in many other cities, asked for enforcement of a regulation limiting parking to thirty minutes. Mr. Powell found that 52 autos could park on the circumference of a typical business block, after allowing for hydrants, safety zones, etc.; that it took a police officer an average of 2 minutes to tag a car and it would therefore, take him 1 3-4 hours to tag all the cars in one block so that, with a 30-minute parking limit would require four policemen to that block to enforce the parking limit. As there are 40 blocks in the congested area of Buffalo and only two policemen are assigned to the 40 blocks, the carrying out of a 30-minute parking regulation would necessarily have to be left to voluntary observance by the automobilists themselves.

Simple. But citizens other than engineers, do not seem to apply even the simplest arithmetic to matters outside of the store or office.

Wards Island for New York Sewage Plant

In our issue of December, 1925 we referred to the desire of the Metropolitan Sewerage Commission that New York City receive back from the state, to which it had been leased, a part of Wards Island to be used for a sewage treatment plant; giving the reason why this seems to be by far the most desirable location available for such a plant.

The legislature which recently adjourned passed a bill, which was approved by the Governor on April 5, which provides for surrendering to the city a part of Wards Island and giving the city the right to construct and operate thereon a sewage disposal plant and to construct and maintain a sewer under the bed of Harlem river to Manhattan Island.

This matter having been satisfactorily adjusted, it is probable that the sewerage commission will proceed to complete plans for a sewage treatment plant at this point and submit the plans for final adoption by the Board of Estimate.

Biscayne Boulevard Lights

In our issue for February, 1927, we described and illustrated designs for traffic signals and light standards which were awarded prizes in a contest held by the Biscayne Boulevard Association. A contract has recently been awarded, amounting to about $62,000, to the Westinghouse Electric and Mfg. Company for the lighting units, most of them of the pendant type. These will consist of Westinghouse-Holophane Bi-Lux refractors, which control the light which would otherwise make bright areas around the standards with areas of darkness between, distributing it with considerable uniformity length-wise of the street. The refractors are enclosed in rectilinear glass globes.

The contract includes 304 standards 16 feet high, 23 standards 19 feet high, 32 standards with lanterns and 35 traffic posts. No traffic towers have yet been ordered.

Rating Water Power

A national agreement on the methods of rating the water power of rivers has been reached tentatively, according to an announcement by the American Engineering Standards Committee. As the question is one of international importance, the cooperation of other countries is being sought before any final decision is made.

The use of horsepower has been common in the past, but as the energy of water power is in practically all cases delivered from the plant in form of electric current, it seemed to be most convenient to express it tentatively in terms of kilowatts. This is the unit recommended for expressing capacity of water power sites, which capacity should express the theoretical potential power without deductions for losses in water wheels, generators, transformers, etc. It is also recommended that the capacity should

be stated for two rates of flow, one called the 90 per cent. of the time flow, corresponding to a flow available 90 per cent. of the time; another called the 50 per cent. of the time flow, corresponding to the flow available one-half of the time.

The committee desires that these tentative rules be discussed fully and frankly by everyone interested in hydraulic development in this country, to the end that they may be so modified that, as finally adopted, they will represent the best American opinion.

Wrapped Garbage in Sioux City

In Sioux City, Iowa, garbage is collected from a population of about 80,000, twice each week in the residential, and three times a week in the congested districts. The collections are made with horse-drawn wagons which are owned, operated and maintained by the drivers. Each wagon carries a load of four yards and is covered with canvas tarpaulins when the load has been completed. The householders are required to drain and wrap all garbage and provide separate containers for rubbish and garbage. The garbage is sold to a hog feeder who pays the city $250 a month. The hog feeding yard is centrally located and in this way a long haul is avoided, the longest haul being five miles and the average haul two miles.

The department collects 7,000 tons of garbage and 18,000 tons of rubbish and ashes annually and keeps within an appropriation of $50,000, and receives about $3,000 a year for the garbage.

Building Roads With Gasoline

North Carolina pays maintenance of highway system, interest on bonds, sinking fund and administration out of gasoline tax and automobile license fees.

By H. K. Witherspoon*

When a gasoline tax was adopted in North Carolina in 1921 at the same time that a bond issue of $50,000,000 was authorized and the statement made that these bonds would be retired, interest on them paid, and the State highway system maintained from the revenue derived from this tax and from automobile license fees, there was considerable skepticism as to whether or not this was possible. The results have exceeded expectations and today North Carolina has a system of roads second to none in the country, which has not cost the taxpayer a penny but which has been paid for entirely by those who use the roads.

Not only has the system been financed as above outlined, but for the past two years a large surplus has been transferred to the construction fund for building new roads. In addition, the overhead operating expenses of the State Highway Commission and those of the Automobile Bureau of the State Department of Revenue which collects the tax, have been paid from this fund, and the tax is being cheerfully paid by the motorists for they see results in the excellent system of roads.

For the past three years receipts from the gasoline tax have shown a steady climb, which clearly indicates that the citizens of the State are taking advantage of their good roads and are doing more driving. This increase is not confined, however, to motorists of North Carolina for, during certain seasons of the year, the State is visited by tourists from every part of the United States.

The following tables show clearly the receipts and expenditures from the above fund:

REVENUE

Gasoline and Auto Collections, June 30, 1922-June 30, 1926.

1922	$ 2,828,649.18
1923	4,900,063.62
1924	6,907,585.79
1925	9,435,925.50
1926	11,915,092.61

DISBURSEMENTS

	Maintenance	Interest on Bonds	Sinking Fund
1922	$2,103,928.46	$ 142,640.00	.....
1923	3,266,556.49	1,127,630.00	.....
1924	3,276,138.80	1,891,692.50	$1,250,000
1925	3,402,738.85	2,756,931.73	1,250,000
1926	4,630,448.19	3,402,570.77	.....

	Administration	Credited to Construction Fund
1922	$202,887.10	.....
1923	221,707.03	.....
1924	223,471.32	.....
1925	250,971.30	$2,619,685.17
1926	257,548.56	3,867,120.22

Two-and-a-Half-Inch Paving Brick in Recognized List

Taking cognizance of an increase in shipments of 2½-inch paving brick from 31,802,533 in 1925 to 58,468,007 in 1926, the "Permanent Committee on Simplification of Variety and Standards for Vitrified Paving Brick of the Department of Commerce of the United States," at its meeting in Washington March 31, reinstated this size in the list of recognized types and sizes of paving brick.

The revised list of recognized types and sizes of vitrified paving brick as determined by the committee and the percentage of total shipments represented by each size is as follows:

Plain Wire-Cut Brick	
2½"x4"x8½"	14.1%
3 "x4"x8½"	38.2%
3½"x4"x8½"	5.9%
Repressed Lug Brick	
4"x3½"x8½"	14.5%
Wire-Cut Lug Brick	
4"x3½"x8½"	6.4%
	79.1%

NOTE:—Remainder of 20.9% made up of special sizes or types not included in recognized list.

The survey of the industry, made by the U. S. Department of Commerce to serve as a basis on which the simplification committee annually makes its decisions, revealed a big increase in total shipments of paving brick for 1926 over 1925. Total shipments for 1925 were 353,588,777. Those for 1926 were 413,125,469, or a gain of 59,536,692 for last year.

The 2½-inch brick was the only size showing a notable gain in percentage of total shipments, representing 8.9 per cent. in 1925 and 14.1 per cent. in 1926.

*Assistant to Chairman, North Carolina State Highway Commission.

Road Construction in 1926

From information furnished by about six hundred and fifty county and state officials, tables have been prepared showing road funds raised and spent in 1926, and length of each kind of improvement.

Through the cooperation of about 600 engineers, surveyors, and other county officials, PUBLIC WORKS presents for the eleventh time its annual survey of county highway construction and practice. To those who furnished data, PUBLIC WORKS extends its thanks, for without their assistance, this information could not have been obtained. A gratifying number of these men took occasion, by letter or notation on the questionnaire, to express their pleasure in furnishing us with the data requested.

Information was asked regarding highway expenditures in 1926, types of roads built in 1926, the total of each type in use at the end of 1926, the use of highway equipment and machinery, and the practice in regard to bridge and culvert width.

From figures presented by these officials it is estimated that the average county spent nearly a quarter of a million dollars in 1926, and that the total expenditure for county road work is now probably in excess of half a billion dollars a year.

Of special interest, as illustrating the general high type of engineering in these counties, were the data received in regard to bridge and culvert width. Analyzing the first 369 replies on this subject, we find 270 counties reporting that, on new construc-

(*Continued on page* 188)

Information Furnished by State Highway Departments

STATE	Standard Width of Surface: Main Roads Feet	Standard Width of Surface: Other Roads Feet	Greatest allowable curvature Main Roads Radius in feet or degrees	Maximum allowable grade Hard Surface Roads Per cent.	Are bridges & culverts full width of roadway, including shoulders?	Are shoulders used; or paved full width?
Arizona	18	16	200a	6	Yes	Shoulders
California	20	...	300 ad	6	Yes	Shoulders ad
Colorado	18	18	500b	6	20 ft.	Shoulders
Connecticut	20c	18-20	300	7	Yes	Shoulders
Delaware	16-18-20	16	6°	6	Yesd	Shoulders
Florida	18	18	5°	6	20e	Shoulderse
Indiana	18	18	f	f	f	Shoulders
Iowa	18-20	None	38°	6	g	Shoulders
Kansas	18	18	500	6	h	Shoulders
Maine	20-27	16-18	No standard	7	Yes	Shoulders
Massachusetts	24-40i	18-20i	No standard	6i	Wider	Both
Michigan	20	18	5° 30′ j	7j	30-40	j
Mississippi	18	16	k	6	k	Shoulders
Missouri	18	18	11° 28′	6	18-20	6-ft. shoulders
Montana	18	18	28°	5l	l	Shoulders
Nebraska	18	18	350	6	m	Shoulders
Nevada	18	15-18	200	6	n	Shoulders
New Hampshire	21	18	23°-250 ft.	7	Yes	3-ft. shoulders
New Mexico	18	12-16	300	6	20 ft.	Shoulders
New York	27	18	500	6	Yesp	Shoulders
North Carolina	18	16	19°	6	20 ft.	Shoulders
North Dakota	20	..	300	6	q	Shoulders
Ohio	18-30	18	250	7	24 ft.	Shoulders
Oklahoma	18	18	500	5	Yes	Shoulders
Oregon	20	16	200	5	Yes	Both
Pennsylvania	18-40r	16-18	6°-8°	6-8	24 ft.	Shoulders
Rhode Island	18s		4°-10°	7	Yes	Shoulders
South Carolina	18	18	10°	5	18 ft.	Shoulders
South Dakota	18	..	...	6	No	Shoulders
Tennessee	18	18	28°	...	t	Shoulders
Texas	20	18	500	5	u	Shoulders
Utah	18	16	200	5	ac	Shoulders
Vermont	18	18	23°	7-8v	Yes	Shoulders
Virginia	18	18	30°w	7-8	24	Shoulders
West Virginia	16-18	16	100 ft.	9x	x	bothx
Wyoming	18-20y	..	Variable	Variable	No	Shoulders
CANADA						
Alberta	20z	16-20	40°	7	18 ft.	....
British Columbia	18	16	...	...	...	....
Manitoba	z	..	....	...	Yes	....
Nova Scotia	16	14	No limit	No limit	Yes	....
Ontario	20	14-16	19°	7	aa	5-ft. shoulders
Prince Edward Island	14	12	No limit	5	ab	Shoulders
Saskatchewan	20z	..	16°	7	...	....

WIDTH OF ROADS AND BRIDGES, GRADES, AND CURVATURE—COMMENTS AND NOTES ON TABLE

a. A radius of 200 feet is used in the mountain sections of Arizona.

b. A radius of 500 feet is usually used in Colorado, but sharper curves are sometimes used in exceptional cases.

c. The usual width of main roads in Connecticut is 20 feet, but the Boston Post road is 40 feet wide.

d. Bridges and culverts up to 40 feet span in Delaware are full width of travelable roadway, including shoulders.

e. In Florida, bridges are made 20 feet wide, but culverts are made the full width of the roadway, including shoulders, which are uniformly 6 feet wide.

f. Indiana uses the standards of the Bureau of Public Roads for maximum curvature and allowable grade. Starting in 1927, plans are being changed so that all bridges and culverts will have a width equal to the full width of the travelable roadway.

g. In Iowa, culverts are made full width; I-beam, slab and deck girder bridges, 24 feet wide; and truss bridges 20 feet wide. Shoulders are 5 feet wide.

h. Bridges are 20 and 24 feet wide in Kansas, but culverts are made the full width of the roadway.

i. In Massachusetts, widths given are used on tangents. The 6 per cent grade is standard, but is deviated from in special cases. Bridges and culverts are made wider than the travelable roadway.

j. Where the curvature can not be held to 5½ degrees,

Michigan uses a sharper curve. A 7 per cent grade is the approximate maximum. Culverts are full width of grade; bridges are 30 feet minimum width, and 40 feet on primary roads. Shoulders are used generally, but curb and gutter occasionally.

k. Mississippi has no fixed practice for curvature. Culverts are made full width of roadway, but not bridges.

l. A 5 per cent grade is standard in Montana, though short stretches are permitted with 6 or 7 per cent. Culverts are made the full width of the roadway, but bridges have a 20-foot roadway.

m. Nebraska makes culverts the full width of the roadway, but bridges are 20 to 22 feet wide.

n. In Nevada, culverts are made full width of the roadway, but large bridges are not.

p. New York uses a radius of not less than 500 feet where possible. Bridges and culverts up to 40 feet span are made full width of travelable roadway. Roads through villages and thickly settled communities are paved full width, but shoulders are used elsewhere.

q. North Dakota builds culverts and slab bridges full width of roadway including shoulders, but not bridges over 22 feet span.

r. Pennsylvania main roads are normally 18 feet in width, but a width of 20 feet is provided on heavy traffic roads adjacent to cities or terminal areas. Dual type paving has been used in widening existing pavements, consisting of adding 10-ft. traffic lanes on either side of existing pavements, resulting in paved roadways 30 to 40 feet in width. The allowable curvature depends on topography and cost, but an effort is made to keep curves below 8 degrees in mountain country and 6 degrees elsewhere. The established maximum grade is 8 per cent, but every reasonable effort is made to keep grades below 6 per cent. The width of roadway on two-lane bridges is 24 feet, and in populous sections, or adjacent to schools and churches in rural sections, footways for pedestrians are added. These vary from 3 to 5 feet in width, or more, on one or both sides, as conditions warrant.

s. Rhode Island laws limit the width of hard surface to 18 feet on tangents, the department being given discretion in the matter of widths at corners and on curves. If a town wishes the metalled surface wider than 18 feet, it must pay the entire cost of constructing the additional width. Because so many roads pass through built-up portions of towns, there is no limit on allowable curvature, but outside of built-up areas, the maximum curvature is kept as near 4 degrees as possible, and seldom exceeds 10 degrees. Except in rare cases, 7 per cent is the maximum grade.

t. Tennessee constructs culverts the full width of the roadway and bridges with a 20 foot roadway.

u. Texas makes culverts 26 feet (the full width of the roadway), and bridges 20 feet wide.

v. Vermont uses a 7 per cent grade, but permits 8 per cent for distances less than 400 feet.

w. Virginia has no limit of curvature, but tries to keep under 30 degrees. There are some 8 per cent grades, but every effort is made not to exceed 7 per cnt.

x. West Virginia permits 9 per cent grades, but seldom exceeds 7 per cent. Bridge roadways are 18 to 20 feet wide and culverts full width.

y. In Wyoming, gravel roads are 18 feet wide.

z. There are no hard surface pavements in the province.

aa. In Ontario, culverts are made full width of roadway, bridges 24 feet, and sidewalks 6 feet.

ab. In Prince Edward Island, roadway width on bridges is 17 feet, but culverts are full width of roadway.

ac. Utah constructs culverts full width of roadway, and bridges 20 feet wide. Shoulders on paved roads are 4 feet wide, and on gravel roads 3 feet.

ad. In California, minimum radius permitted in mountains is 250 ft. on open curves and 300 ft. on blind curves; increased where topographical conditions permit. General practice, 2 ft. to 5 ft. dirt shoulders on each side; in some cases grade paved full width.

Information Furnished by County Highway Officials

Money Spent in 1926 in Maintaining and Constructing Roads

State and County.	Sources of Funds Used for Maintenance and Construction				Amount spent on maintenance
	Total Spent	Local	State	Federal Aid	Other	
Alabama:						
Bullock	$100,000	$10,000	$60,000	a	$30,000	$5,000
Clarke	25,000	10,000	20,000	.....	.....	12,500
Coffee	50,000	15,000	35,000	.....	.....	15,000
Crenshaw	65,000	None	10,000	10,000	None	50,000
Franklin	187,000	15,000	172,000	None	.....	40,000
Jackson	475,000	75,000	400,000	.....	.....	40,000
Pike	50,000	None	None	None	.....	36,000
Arkansas:						
Cleveland	7,000	None	All	None	.....	7,000
Dallas	22,348	10,000	12,348	.....	.....	10,000
Hot Springs	110,000	44,000	60,000	None	None	6,000
Phillips	60,000	33,000	27,000	None	None	60,000
California:						
Alameda	856,820	208,812	648,008	.....	.....	.....
Fresno	1,033,852	None	372,534	None	None	910,558
San Luis Obispo	200,000	150,000	50,000	.....	.....	.....
Sutter	488,475	459,533	28,941	None	None	82,337
Tehama	167,240	.....	25,248	.....	.....	.....
Colorado:						
Lake	21,000	7,500	7,500	6,000	.....	15,000
Larimer	244,829	178,762	94,557	.....	.....	108,844
Las Animas	350,000	50,000	150,000	150,000	.....	20,000
Logan	67,000	60,000	25,000	None	.....	Most
Mesa	160,000	70,000	30,000	55,000	5,000	70,000
Washington	98,581	.....	32,860	None	.....	49,290
Delaware:						
Sussex	149,335	368,834	10,000	.....	35,786	77,528
Florida:						
Collier	608,978	338,978	270,000	7%b	.....	48,624
De Soto	100,000	.....	40,000	.....	.....	15,000
Putnam	553,336	All	c	c	c	100,560
Santa Rosa	60,000	35,000	25,000	None	None	45,000
Sarasota	1,703,959	1,703,959	None	None	None	192,455
Taylor	180,000	140,000	40,000	None	None	40,000
Georgia:						
Camden	500,000	50,000	.....	450,000a	.....	20,000
Echols	12,000	All	None	None	None	3,600
Evans	30,000	27,000	3,000	None	None	8,000
Terrell	72,000	All	None	None	None	72,000
Wilcox	15,802	5,334	10,802	None	None	15,802
Worth	114,886	94,886	20,000	.....	.....	24,901
Idaho:						
Bonneville	300,949	171,730	None	129,219	.....	54,656
Bonner	337,239	107,804	4,435	111,000	114,000	32,021
Franklin	64,774	60,774	4,000	None	None	10,716
Kootenai	80,316	54,442	None	25,873	None	13,000
Lewis	16,000	.....	None	None	.....	None
Madison	10,237	10,237	.....	.....	.....	10,237

State and County.	Sources of Funds Used for Maintenance and Construction					Amount spent on maintenance
	Total Spent	Local	State	Federal Aid	Other	
Idaho (continued)						
Orofino	132,412	65,973	26,595	39,863	.....	.....
Owyhee	14,553	14,553	None	None	None	14,553
Power	17,361	17,361	.....	.....	.....	7,770
Shoshone	240,589	240,589	None	.....	.....	84,308
Illinois:						
Carroll	510,000	150,000	360,000	None	None	95,000
Champaign	92,000	92,000	None	None	None	.....
De Kalb	70,000	70,000	None	None	None	45,000
Douglas	178,000	178,000	None	None	None	163,000
Effingham	79,000	20,000	5,000	.....	.....	74,000
Fulton	3,000,000	300,000	2,700,000	.....	.....	150,000d
Grundy	125,000	.....	None	None	.....	30,000
Hancock	182,000	47,000	.....	.....	135,000	100,000
Iroquois	.....	80,000	.....	.....	.....	80,000
Jasper	58,000	.....	.....	None	None	45,000
Kane	200,000	200,000	.....	.....	.....	100,000
Kankakee	38,410	38,410	18,596	None	.....	1,000
Lake	912,000	212,000	600,000	None	100,000	85,000
Livingston	139,000	120,000	19,000	None	.....	23,782
Macoupin	57,000	57,000	.....	.....	.....	.....
Menard	81,361	18,000	None	None	.....	7,000
Peoria	562,513	173,158	210,000	None	129,355	216,310d
Pulaski	50,000	50,000	.....	.....	.....	40,000
Richland	41,285	.....	None	None	None	.....
Sangamon	110,000	110,000	None	None	None	95,000
Stephenson	162,000	58,000	None	None	102,000	105,000
Vermilion	25,000	25,000	None	None	None	25,000
White	.....	125,000	.....	.....	.....	30,000
Whiteside	179,166	65,000	.....	.....	144,166	65,000
Winnebago	160,000	160,000	.....	.....	.....	.....
Woodford	141,843	141,843	None	None	.....	42,715
Indiana:						
Boone	94,803	67,484	25,032	.....	72,738	48,239
Carroll	151,762	.....	.....	.....	.....	76,762
Crawford	19,000	6,000	13,000	.....	.....	19,000
De Kalb	140,000	136,000	14,000	.....	.....	40,000
Grant	178,000	166,000	.....	.....	27,000g	.....
Huntington	89,996	80,953	22,606	None	2,948	89,996
Jefferson	175,000	158,000	17,000	None	.....	40,000
Martin	22,000	.....	.....	.....	.....	.....
Marshall	80,000	60,000	20,000g	.....	.....	60,000
Miami	95,697	94,199	.....	.....	.....	.....
Newton	142,211	61,000	31,000	31,000	19,211g	.....
Putnam	111,000	85,000	26,000	None	None	85,000
Steuben	150,000	.....	13,000g	.....	.....	.....
Washington	47,000	47,000	.....	.....	.....	47,000
Wells	109,000	80,000	29,000	.....	.....	109,000
White	100,000	78,000	22,000	.....	.....	72,000
Iowa:						
Audubon	116,261	116,261	None	None	None	15%
Benton	160,000	.....	.....	.....	.....	.....
Black Hawk	129,249	86,974	37,293	.....	5,161	63,001
Boone	92,000	.....	.....	49,000	.....	49,000
Bremer	155,525	.....	48,705	.....	106,820	67,276
Buchanan	101,000	56,000	45,000	.....	.....	64,000
Buena Vista	212,000	42,000	100,000	a	70,000	70,000
Calhoun	123,340	73,340	50,000	.....	.....	27,118
Cerro Gordo	201,000	175,000	26,000	.....	.....	46,000
Cherokee	45,000	30,000	15,000g	None	None	25,000
Chickasaw	39,244	25,000	14,000	.....	.....	10,000
Clarke	105,000	25,000	55,000	.....	25,000	60,000
Clayton	236,000	145,000	91,000	.....	.....	58,000
Crawford	300,000	175,000	100,000	25,000	.....	75,000
Creston	38,694	.....	.....	.....	.....	18,823
Dallas	284,500	181,300	48,500	.....	54,700	164,600
Decatur	60,057	34,906	25,150	.....	.....	60,057
Delaware	78,000	.....	30,000	.....	.....	50,000
Dickinson	100,000	30,000	50,000	.....	20,000	45,000
Dubuque	370,000	370,000	40,000	.....	.....	70,000
Emmet	110,764	85,272	25,497	None	None	58,725
Fayette	129,000	.....	60,000	.....	.....	80,000
Floyd	56,483	31,084	2,039	.....	13,894	9,465
Grundy	14,000	1,000	8,000	.....	.....	30,000
Hancock	135,000	90,000	45,000	.....	.....	65,000
Harrison	23,347	11,347	None	None	.....	17,500
Howard	83,000	33,000	50,000	.....	.....	43,000
Jackson	179,644	25,725	153,919	.....	.....	58,597
Johnson	224,546	224,546	None	None	.....	38,550
Jones	125,000	25,000	80,000	20,000	.....	60,000
Kossuth	350,000	100,000	250,000	None	.....	110,000
Linn	400,000	280,000	.....	.....	120,000d	175,000
Lucas	130,000	30,000	75,000	.....	25,000	50,000
Lyon	162,664	128,799	33,844	.....	.....	22,712
Madison	185,000	116,800	68,200	.....	.....	98,500
Marion	88,997	.....	None	None	None	63,997
Marshall	221,400	59,900	112,000	.....	51,500d	87,600
Monona	24,427	24,427	None	None	None	13,430
O'Brien	101,011	84,816	16,194g	.....	.....	28,374
Osceola	120,000	42,000	78,000	.....	.....	30,000
Palo Alto	252,000	163,685	88,315	.....	.....	77,244
Plymouth	575,000	125,000	450,000	.....	.....	70,000
Pocahontas	234,685	149,677	85,008	None	.....	130,057
Poweshiek	125,000	75,000	50,000	.....	.....	75,000
Sac	215,552	68,636	55,885	.....	91,030d	139,842
Scott	757,209	560,099	70,709	126,400	.....	161,685
Shelby	165,000	130,000	35,000	.....	.....	165,000
Sioux	176,617	.....	None	.....	.....	30,722
Story	150,000	100,000	50,000	None	None	75,000
Taylor	35,000	21,000	14,000	.....	.....	30,000
Wayne	53,000	25,000	28,000	.....	.....	53,000
Winneshiek	118,629	118,629	None	None	None	40,000
Kansas:						
Anderson	97,000	37,000	60,000	None	.....	20,000
Barber	125,000	36,000	10,000	20,000	40,000	25,000
Bourbon	319,828	.....	53,325	98,719	.....	200,000
Brown	334,763	153,496	25,063	21,303	101,877d	58,067
Butler	350,000	200,000	26,000	124,000	.....	55,000

State and County.	Sources of Funds Used for Maintenance and Construction					
	Total Spent	Local	State	Federal Aid	Other	Amount spent on maintenance
Kansas (continued)						
Chase	70,000	55,000	.....	15,000	.....	16,000
Chautauqua	70,000	25,000	15,000	.....	30,000d	10,000
Cherokee	264,000	.....	.....	45,000	219,000	35,000
Cheyenne	72,296	56,874	15,421	.....	.....	17,421
Cowley	665,663	507,655	95,000	63,008	None	189,800
Douglas	152,208	152,208	None	None	None	50,881
Ellis	100,000	28,000	48,000	24,000	.....	12,000
Geary	352,000	200,000i	11,330	15,000	.....	19,446
Gove	45,488	20,018	25,470	.....	.....	18,377
Haskell	54,000	16,000	35,000	.....	3,000	14,000
Hodgeman	42,496	5,616	36,879	None	None	18,000
Jackson	111,000	73,000	.....	38,000	None	18,500
Kingman	200,000	150,000	10,000	40,000	.....	30,000
Lyon	216,000	139,000	34,000	43,000	.....	94,000
Marshall	400,000	.....	16,287	48,000	.....	150,000
McPherson	320,697	195,058	100,481	25,157	.....	68,595
Neosho	180,600	153,030	None	27,570	None	44,400
Ottawa	120,389	32,692	24,117	14,098	23,313	26,000
Osage	200,000	.....	.....	.....	.....	.....
Phillips	120,570	86,797	18,800	14,972	None	39,611
Pottawatomie	250,331	.....	54,000	None	.....	57,829
Pratt	155,111	28,908	78,057	None	40,191	47,790
Reno	300,000	250,000	None	50,000	.....	130,000
Riley	131,507	.....	16,990	38,000	.....	50,240
Republic	200,000	86,000	67,000	43,000	6,000	55,000d
Rooks	144,609	20,795	43,864	24,863	55,087	22,423
Rush	48,000	17,000	31,000	.....	.....	11,000
Sheridan	118,064	38,816	41,917	12,000	None	33,504
Thomas	96,141	14,000	36,874	10,859	.....	.....
Wabaunsee	170,000	85,000	40,000	15,000	.....	30,000
Wallace	40,894	18,177	22,716	.....	.....	6,875
Woodson	40,600	40,000	None	None	None	23,000
Kentucky:						
Butler	15,000	15,000	None	None	None	None
Fayette	117,000	117,000	.....	.....	.....	.....
Floyd	30,000	30,000	.....	.....	.....	22,500
Mercer	65,000	30,000	35,000	.....	.....	35,000
Ohio	100,000	.....	.....	.....	.....	.....
Rockcastle	100,000	10,000	50,000	40,000	.....	20,000
Scott	351,263	.....	145,000	135,000	.....	71,263
Louisiana:						
Beauregard	109,500	109,500	.....	.....	.....	54,000
Bogalusa	60,000	60,000	None	None	None	20,000
Jefferson	650,000	425,000	225,000	.....	.....	50,000
St. John the Baptist	None	.....	.....	.....	.....	.....
Maryland:						
Prince George	180,000	120,000	30,000	30,000	.....	108,000
Michigan:						
Allegan	233,448	233,448	None	None	None	40,000
Branch	143,249	77,474	65,775	.....	.....	48,592
Calhoun	158,313	32,684	160,000	None	43,019	80,876
Cass	50,000	30,000	20,000	None	None	30,000
Chippewa	155,287	85,000	75,000	.....	.....	65,000
Genesee	1,417,101	1,219,417	109,801	.....	87,881	396,646
Huron	400,000	270,000	130,000	.....	.....	60,000
Isabella	120,000	31,000	40,000	None	50,000	60,000
Jackson	429,904	.....	202,130	.....	227,773	155,056
Kalamazoo	386,725	228,271	106,072	None	166,729	173,328
Leelanau	95,081	27,844	67,237	None	.....	27,388
Livingston	100,000	70,000	30,000	.....	.....	30,000
Manistee	77,560	33,214	37,304	.....	688	21,497
Mason	88,019	41,592	20,953	None	36,772	26,747
Shiawassee	162,107	48,000	119,210	None	.....	67,210
Minnesota:						
Aitkin	71,115	71,115	None	None	None	37,347
Becker	86,615	65,340	21,275	None	None	13,769
Beltrami	78,328	58,018	17,709	.....	458	15,979
Benton	80,000	60,000	20,000	None	.....	13,000
Big Stone	64,933	42,329	22,603	None	None	14,494
Blue Earth	200,000	.....	130,000	.....	.....	60,000
Brown	252,041	.....	20,000	None	None	46,138
Carlton	90,541	70,541	20,000	None	None	18,000
Carver	142,417	100,733	21,833	.....	6,987	24,360
Chippewa	120,974	35,256	.....	.....	240	26,239
Chisago	114,222	89,413	24,808	None	.....	30,634
Clearwater	72,000	47,000	25,000	.....	.....	29,000
Cottonwood	146,058	69,199	19,690	.....	38,419	20,736
Crow Wing	75,000	55,000	20,000	.....	.....	30,000
Dakota	188,614	138,141	14,171	21,811	18,029	42,806
Dodge	125,250	.....	19,000	.....	.....	19,377
Douglas	125,776	111,283	14,493	.....	.....	15,122
Faribault	170,133	147,405	22,728	None	None	40,474
Goodhue	342,849	316,549	26,300	.....	.....	35,750
Grant	132,000	112,000	20,000	None	None	10,000
Hubbard	40,000	.....	19,000	None	None	8,000
Jackson	142,615	123,481	19,134	None	None	28,990
Kandiyohi	226,642	.....	19,000	None	None	17,507
Lac qui Parle	117,114	88,056	25,594	None	3,462	27,636
Lake	57,912	33,123	22,782	9,232	5,975	20,287
Le Sueur	166,000	140,000	21,000	None	None	30,000
Lyon	169,550	None	51,628	None	119,009	54,290
Marshall	200,886	94,275	14,717	.....	.....	38,000
Martin	63,273	42,713	20,560	None	None	32,080
McLeod	149,686	.....	19,687	.....	.....	25,000
Meeker	137,000	117,000	20,000	.....	.....	17,000
Morrison	123,055	.....	19,687	.....	.....	40,105
Nobles	203,815	168,146	32,687	None	2,981	38,228
Norman	75,000	.....	20,000	.....	.....	20,000
Olmstead	143,274	.....	34,633	.....	.....	67,618
Otter Tail	255,000	200,000	24,000	None	31,000	41,000
Pipestone	65,000	.....	19,000	.....	.....	27,500
Polk	222,376	.....	21,000	None	.....	27,418
Ramsey	2,305,968	2,256,071	49,896	None	None	231,585
Red Lake	49,487	30,476	17,327	None	1,683	18,844
Rice	149,275	.....	17,225	None	None	29,644
Rock	59,546	None	18,922	None	.....	16,241
Roseau	56,621	37,170	19,540	None	None	10,768

State and County.	Total Spent	Sources of Funds Used for Maintenance and Construction				Amount spent on maintenance
		Local	State	Federal Aid	Other	
Minesota (continued)						
Scott	133,477	96,477	20,000	None	17,000	22,948
Sherburne	44,842	23,858	20,894	.....	.....	6,686
Sibley	100,600	75,603	14,216	.....	3,861	20,777
Stearns	139,000	100,000	39,000	.....	.....	29,000
Steele	100,999	.....	17,000	None	None	24,200
Swift	110,010	74,032	22,591	None	16,994	34,559
Todd	140,000	.....	19,600	.....	.....	29,000
Wadena	325,000	85,000	240,000	None	.....	40,000
Wasica	165,353	.....	16,720	None	.....	.....
Washington	174,088	119,558	54,529	.....	.....	30,000
Watonwan	85,000	65,000	20,000	.....	.....	19,000
Wilkin	79,905	55,232	23,730	.....	942	12,079
Wright	231,000	209,000	22,000	None	.....	80,000
Mississippi:						
Warren	80,000	80,000	None	None	None	40,000
Missouri:						
Atchison	124,000	124,000	None	None	None	50,000
Barry	59,000	59,000	None	None	None	59,000
Boone	30,000	30,000	None	None	None	10,000
Butler	40,000	40,000	None	None	.....	25,000
Clinton	59,964	59,964	None	None	None	None
Cole	69,000	.....	.....	.....	.....	.....
Dallas	30,000	30,000	.....	.....	.....	3,000
Daviess	500,000	75,000	425,000	.....	.....	20,000
Holt	.....	56,000	.....	.....	None	25,000
Monroe	50,000	50,000	None	None	.....	50,000
Pettis	16,843	6,805	None	None	10,034	None
St. Clair	129,837	38,734	91,205	.....	.....	27,624
Montana:						
Beaverhead	80,422	520,826	None	None	28,394	21,767
Carbon	141,843	107,891	33,952	30%	.....	.....
Daniels	45,400	16,117	None	None	29,282	7,000
Gallatin	130,000	119,500	2,500	8,000	.....	46,000
Missoula	117,480	37,541	.....	26,800	53,139	72,000
Petroleum	40,000	27,000	13,000	.....	.....	2,000
Ravalli	50,000	49,500	500	250	None	25,000
Roosevelt	36,422	36,422	.....	.....	.....	.....
Rosebud	115,000	115,000	None	None	None	28%
Sheridan	46,888	35,530	29,460	None	717	4,001
Wheatland	20,000	20,000	.....	.....	.....	6,600
Nebraska:						
Clay	30,000	25,000	5,000	.....	.....	18,000
Hall	100,294	100,294	.....	.....	.....	29,925
Holt	30,800	30,800	.....	.....	.....	15,000
Knox	82,653	44,653	38,000	14,000	None	10,000
Lancaster	470,000	287,000	183,000	60,000	None	200,000
North Platte	243,000	50,000	86,500	86,500	.....	55,000
Nuckolls	.....	.....	.....	.....	.....	29,290
Otoe	200,000	200,000	.....	.....	.....	30,000
Richardson	125,000	50,000	50,000	25,000	.....	30,000
Saunders	89,207	89,207	None	None	None	65,399
New Jersey:						
Camden	795,493	654,906	140,587	None	None	182,534
Essex	1,246,085	.....	253,000	.....	.....	253,000
Mercer	1,471,212	260,946	250,000	None	79,962	241,086
Morris	425,000	.....	98,099	.....	.....	298,099
New Mexico:						
Luna	7,000	7,000	.....	.....	.....	.....
Rio Arriba	10,000	10,000	None	None	None	10,000
New York:						
Chautauqua	1,844,000	316,400	741,100	170,000	616,700	763,400
Essex	308,286	38,730	308,285	.....	.....	.....
Jefferson	550,000	414,000	66,000	None	70,000	140,000
Madison	260,000	153,510	78,489	.....	28,000	135,000
Onondaga	901,847	582,893	318,954	.....	.....	49,115
Orleans	.....	89,659	21,600	.....	.....	6,259
Oswego	465,000	325,000	140,000	.....	.....	60,000
Steuben	1,355,000	500,000	560,000	225,000	70,000	350,000
Suffolk	1,548,313	58,590	225,611	140,477	1,123,634	807,053
Wyoming	333,957	.....	.....	.....	.....	.....
Yates	75,000	23,070	23,070	.....	.....	27,000
North Carolina:						
Ashe	100,000	.....	.....	.....	.....	.....
Cabarrus	100,000	100,000	None	None	None	30,000
Caldwell	20,000	20,000	.....	.....	.....	20,000
Gates	125,000	.....	.....	.....	.....	18,000
Mecklenburg	370,000	.....	.....	.....	.....	185,000
Perquimans	24,438	24,438	.....	.....	.....	.....
Pitt	96,000	96,000	None	None	.....	96,000
Scotland	375,000	75,000	.....	.....	300,000	30,000
Wayne	.....	.....	None	None	.....	.....
North Dakota:						
La Moure	300,000	150,000	50,000	100,000	None	75,000
McIntosh	60,000	.....	.....	.....	.....	.....
Stutsman	174,260	78,147	22,503	45,007	28,603	38,000
Walsh	57,000	17,250	14,250	28,500	.....	3,000
Ohio:						
Ashtabula	990,000	484,600	105,000	219,000	181,400	50,000
Butler	226,000	226,000	None	None	.....	80,000
Carroll	468,691	157,607	173,607	121,845	15,631	20,000
Clark	457,270	185,389	97,581	111,081	....	63,219
Darke	200,000	200,000	None	None	None	200,000
Fayette	72,000	.....	15,000	None	40,000	72,000
Hamilton	1,126,000	1,126,000	86,000	None	None	200,000
Highland	51,000	None	40,000	None	11,000	44,000
Hocking	102,000	40,800	61,200	.....	.....	102,000
Jefferson	425,000	325,000	60,000	40,000	.....	195,000
Lucas	2,145,245	.....	56,512	88,000	.....	250,000
Medina	372,073	.....	80,000	70,000	None	57,306
Marion	640,000	430,000	210,000	40,000	.....	430,000
Miami	191,700	.....	56,000	.....	.....	98,700
Morgan	35,000	30,000	5,000	.....	.....	7,000
Morrow	80,000	15,000	10,000	10,000	45,000	20,000
Muskingum	283,633	160,951	95,382	27,300	.....	50,574
Pickaway	100,000	50,000	45,000	5,000	.....	60,000

State and County.	Sources of Funds Used for Maintenance and Construction					
Ohio (continued)	**Total Spent**	**Local**	**State**	**Federal Aid**	**Other**	**Amount spent on maintenance**
Preble	400,000	.....	200,000	60,000	.....	40,000
Richland	350,000	200,000	40,000	43,500	64,500	80,000
Sandusky	423,500	240,000	80,000	79,500	24,000	140,000
Union	250,000	137,500	76,500	.....	36,000	135,000
Warren	896,740	438,242	None	None	458,498	130,989
Wayne	326,500	221,500	15,000	.....	.....	90,000
Williams	250,000	50,000	66,000	60,000	74,000	70,000
Wood	570,000	293,000	78,000	49,000	.....	150,000
Oklahoma:						
Blaine	51,228	1,756	49,472	.....	.....	32,981
Garfield	190,000	190,000	None	None	None	50,000
Kingfisher	301,000	91,000	159,000	51,000	None	8,000
Roger Mills	120,000	120,000	.....	.....	.....	75,000
Wagoner	52,200	43,700	7,500	None	None	22,000
Woods	222,729	.....	92,565	None	.....	13,565
Oregon:						
Douglas	300,000	.....	.....	.....	.....	100,000
Linn	561,116	478,944	82,171	None	.....	200,000
Yamhill	170,000	138,000	32,000	.....	.....	70,000
South Carolina:						
Chester	200,500	92,000	90,500	18,000	.....	125,000
Georgetown	34,000	16,000	.....	.....	18,000	.....
Kershaw	155,791	101,791	1,000	None	53,000	60,000
Sumter	55,000	55,000	.....	.....	.....	55,000
South Dakota:						
Belle Fourche	75,000	.....	37,500	15,000	22,500	20,000
Beadle	163,062	.....	5,325	.....	.....	68,766
Day	103,345	64,634	28,628	10,083	.....	43,628
Davison	67,000	20,000	36,000	.....	10,000	17,000
Douglas	14,257	14,257	None	.....	.....	8,817
Hutchinson	110,629	40,000	19,010	2,250	49,369	36,760
Lawrence	98,139	80,000	15,000	3,000	500	20,000
McCook	64,473	None	.....	27,877	None	32,567
Miner	32,026	.....	None	None	None	11,043
Roberts	88,193	.....	7,813	.....	.....	7,813
Sanborn	102,602	88,298	14,304	.....	.....	27,303
Union	95,188	30,095	17,224	.....	24,419	23,458
Tennessee:						
Benton	75,000	8,000	7,000	None	g	75,000
Haywood	50,000	30,000	17,000	.....	.....	50,000
Henry	60,000	34,000	26,000	None	.....	60,000
Madison	100,000	100,000	.....	.....	.....	100,000
Montgomery	57,000	57,000	None	None	None	45,600
Texas:						
Andrews	4,500	4,500	None	None	None	.....
Armstrong	8,000	6,000	None	None	2,000	8,000
Castro	15,000	11,000	4,000	.....	.....	10,000
Hansford	3,000	3,000	.....	.....	.....	.....
Mason	41,000	25,000	16,000	.....	.....	.....
Nolan	250,000	150,000	50,000	50,000	.....	.....
Yoakum	.....	.....	.....	None	.....	.....
Virginia:						
Bedford	310,000	110,000	100,000	100,000	.....	55,000
Dinwiddie	50,000	20,000	30,000	.....	.....	125,000
Henry	51,500	43,900	7,600	None	None	21,000
Mecklenburg	100,925	.....	.....	.....	.....	Most
Russell	109,376	93,376	26,000	None	.....	About 66%
Tazewell	123,000	.....	.....	.....	.....	85%
Warwick	27,000	22,000	5,000	None	None	21,000
Washington:						
Adams	175,110	133,110	42,000	None	None	15,500
Asotin	35,000	30,500	4,500	None	None	32,000
Clallam	181,436	181,436	.....	.....	.....	31,436
Cowlitz	280,000	245,000	35,000	.....	.....	220,000
Douglas	45,000	28,000	17,000	.....	.....	28,000
Franklin	115,000	.....	16,000	.....	.....	28,500
Gray's Harbor	599,560	540,798	86,618	.....	1,200	137,154
Lincoln	452,000	175,000	239,500	27,500	10,000	150,500
Pend Oreille	70,543	63,877	6,666	None	None	49,421
Skamania	78,000	.....	8,000	None	None	.....
Walla Walla	377,000	317,000	60,000	None	None	137,000
Whatcom	190,500	168,000	22,500	.....	.....	82,000
West Virginia:						
Boone	142,000	142,000	None	None	None	.....
Tyler	85,000	85,000	None	None	None	25,000
Wirt	16,765	16,765	None	None	None	75%
Wyoming	425,000	425,000	None	None	None	100,000
Wisconsin:						
Adams	237,000	21,895	151,105	64,000	.....	56,555
Bayfield	206,391	55,705	128,686	22,000	.....	76,303
Columbia	376,326	188,125	159,201	29,000	.....	186,144
Dane	619,936	.....	136,421	217,713	650	.....
Dunn	501,000	30,000	121,000	350,000	.....	151,000
Fond du Lac	470,000	280,026	141,973	50,000	None	104,203
Grant	510,184	230,056	207,631	130,000	72,496	90,226
Green Lake	251,000	78,000	43,000	130,000	.....	57,000
Juneau	138,591	.....	.....	.....	.....	31,064
Lafayette	338,705	172,722	165,893	.....	.....	84,888
Polk	245,698	87,718	108,573	.....	49,406	157,345
Richland	196,678	27,497	103,651	.....	.....	65,530
Sauk	347,011	253,664	93,346	None	.....	128,204
Vernon	307,565	200,565	107,000	None	.....	173,830
Walworth	246,106	120,917	125,188	.....	.....	77,791
Washburn	239,763	13,500	143,763	85,500	.....	61,263
Washington	313,145	140,145	30,000	143,000	None	56,834
Waushara	89,770	30,000	47,000	None	10,976	47,000
Wood	459,000	309,000	150,000	.....	.....	94,500
Wyoming:						
Campbell	43,504	43,504	.....	.....	.....	2,600
Natrona	126,820	57,522	None	None	71,535	53,648
Sheridan	275,546h	60,726	96,602	87,875	29,324	86,074

a—Included in State aid; b—7% of State aid; c—Not included in total; d—including townships; g—From gas tax; h—includes city of Sheridan; i—For city paving.

(Continued from page 182)

tion, all culverts and bridges would be the full width of the travelable roadway, including shoulders; 22 counties reported all culverts, but not all bridges as being made full width; and 14 reported culverts only in this class. Fourteen counties reported some structures, presumably on the important roads, as being made the full width of pavement and shoulders; 31 counties stated they were not following this practice.

The improvement in highway practice that is taking place is illustrated by comparing the above with conditions as to existing structures. Of these counties, 28 reported having no full-width bridges or even culverts, and less than 10 percent are full width in 52 counties; less than 30 percent in 102 counties; less than 50 percent in 160 counties; less than 80 percent in 212 counties; and over 90 percent in only 35. In 31 counties culverts but not bridges are full width.

Road Construction in Counties in 1926

Bituminous Concrete

	Miles Built in 1926	Miles in County, end of 1926	Width of Improved Surface
California:			
Alameda	10.1	10.1	.....
Fresno	.....	220	16
San Luis Obispo	.....	17	15
Sutter	.....	11.8	17½
Florida:			
Sarasota	120	120	18
Idaho:			
Bonneville	7	13½	18
Illinois:			
Lake	.....	5	30
Indiana:			
Huntingdon	.....	5.3	.....
Marshall	12	12	18
Miami	.....	4	18
Kentucky:			
Fayette	.....	4¼	.....
Michigan:			
Genesee	.....	21.2	18
Jackson	.....	42	20
Kalamazoo	.....	23.3	.....
Minnesota:			
Ramsey	¼	4¼	20-36
Nebraska:			
Lancaster	.....	3	.....
New Jersey:			
Camden	.....	49.9	20
Essex	.....	124	.....
Mercer	6.2	16½	18-20
Ohio:			
Marion	.....	5.5	16-18
Richland	6	.....	18
Warren	1.7	2.3	26
Wayne	.....	3½	16
Williams	.....	5	16
Wood	.....	34	16-18
Oregon:			
Douglas	.....	½	16
South Carolina:			
Chester	.....	106	16

Bituminous Macadam

	Miles Built in 1926	Miles in County, end of 1926	Width of Improved Surface
California:			
Sutter	7.9	58	15
Colorado:			
Kings	.....	101	.....
Delaware:			
Sussex	3	.....	.....
Georgia:			
Worth	.....	5	18
Illinois:			
Lake	.....	5	30
Livingston	.....	2½	15
Indiana:			
Carroll	1	.....	.....
Grant	.....	39	18
Huntington	.....	1	.....
Kansas:			
Bourbon	13	108	.....
Kentucky:			
Fayette	.....	16¼	.....
Michigan:			
Cass	1½	.....	.....
Huron	6	5	20
Kalamazoo	.....	54.6	24-26
Minnesota:			
Ramsey	.....	4.1	9a
Mississippi:			
Warren	.....	45	14
Missouri:			
Pettis	.....	4½	18
New Jersey:			
Camden	.....	7.3	14
Essex	.....	9.9	.....
Mercer	1	20.6	18-20
Morris	7	21.2	18
New York:			
Chautauqua	15	46.7	.....
Jefferson	43	295	10
Madison	10	59	10-16
Onondaga	4.8T	.....	.....
Orleans	7	35.9	14
Oswego	20	117	14
Steuben	33	.....	10
Wyoming	8	.....	.....
Yates	4	.....	.....
North Carolina:			
Mecklenburg	10	.....	18
Ohio:			
Ashtabula	.....	75½	10-16
Butler	.....	5.6	.....
Clark	3	.....	18
Hamilton	60	100	16-20
Highland	.....	60	16
Lucas	15	212	16-20
Jefferson	22	102	10-16
Marion	.....	42.1	16-18
Miami	.....	12	.....
Medina	2.7	30.7	10-18
Monroe	.....	3	14
Muskingum	.....	3.9	.....
Morrow	.....	75	10-18
Ottawa	12	503	16
Preble	.....	24	18
Sandusky	3	114	10-18
Warren	3.8	162	16-20
Wayne	3	13½	16-18
Williams	.....	5	16
Wood	34	320	12-16
Texas:			
Nolan	.....	37	16-18
Virginia:			
Bedford	½	.....	14
Tazewell	.....	75	16
West Virginia:			
Tyler	10	15	16
Wisconsin:			
Richland	.....	2.1	20
Sauk	.....	2	.....

a—9-ft. center strip, dual type; T—by town.

Warrenite-Bitulithic

	Miles Built in 1926	Miles in County, end of 1926	Width of Improved Surface
Californin:			
Alameda	2.3	8	.....
Colorado:			
Las Animas	6.7	14	18
Mesa	3½	7½	16-36
Idaho:			
Shoshone	6	22	24
Iowa:			
Dallas	.....	¼	24
Kentucky:			
Fayette	.....	2.9	16
Louisiana:			
Jefferson	15	.....	20
Minnesota:			
Ramsey	¼	¼	36
Nebraska:			
Lancaster	¼	1	.....
Washington:			
Franklin	.....	2	.....
Gray's Harbor	.....	1.5	18
Wyoming:			
Sheridan c	.....	10	30-48

c—City and county.

Concrete Reinforced

	Miles Built in 1926	Miles in County, end of 1926	Width of Improved Surface
California:			
Sutter	.....	10.	15
Colorado:			
Larimer	.....	21.5	26
Florida:			
Santa Rosa	.....	8	9-18
Idaho:			
Shoshone	.....	2	24
Illinois:			
Champaign	3¼	126	9a
DeKalb	.....	50	18-20
Douglas	.....	16	18
Effingham	1/6	65	18
Fulton	10	97	18
Kane	3	110	18
Lake	26	141	30
Whiteside	8	.....	.....
Winnebago	1.3	88	18
Indiana:			
Jefferson	5.3	.....	.....
Marshall	2½	2½	18
Miami	.....	13.7	18
Newton	2½	4½	18
Iowa:			
Benton	2	.....	18
Black Hawk	.....	49	18
Buchanan	.....	15	18
Cerro Gordo	.....	35	18
Kossuth	.....	13	18
Palo Alto	.....	11	18
Plymouth	18	.....	20
Scott	16	61.3	18
Kansas:			
Butler	6	6	18
Chautauqua	.....	2½	18
Lyon	.....	24	18
Neosho	.....	¼	16
Kentucky:			
Fayette	.....	3½	18
Rockcastle	4	4	18
Michigan:			
Calhoun	.....	2	.....
Genesee	10	25.1	20
Huron	2	25	20
Livingston	.....	28	20
Minnesota:			
Ramsey	8.2	54.1	20-27
Sherburne	.....	43	18
Swift	.....	7.4	18
Watonwan	.....	16	18
Missouri:			
Daviess	12	15	18
Holt	2	4	18
New Jersey:			
Essex	4.6	15.6	.....
Camden	12.6	23.3	20
Mercer	5.8	23.5	20
New York:			
Orleans	.....	2¾	16
Chautauqua	17	183.1	16-18
Jefferson	1	3.7	16
Suffolk	24.9	125.7	16-20
Steuben	20	.....	16-18
North Carolina:			
Pitt	.....	102	16
Scotland	.....	21	18
Ohio:			
Ashtabula	9.6	40.6	.....
Butler	7	8.8	.....
Clark	5.1	.....	20
Lucas	12b	84.8b	18-20
Marion	2	2	18
Miami	3	50	18
Medina	.....	7.2	10-16
Morrow	.....	22	16-18
Muskingum	1	5.1	20
Ottawa	4	15.1	16-18
Richland	3	.....	18
Sandusky	.....	16	16-18
Union	2	.....	18
Warren	.47	6.7	20-30
Wayne	.....	2	10
Wood	2	13	16-18
Oklahoma:			
Woods	1	1	18
South Dakota:			
Union	.....	½	20
Washington:			
Whatcom	.....	134½	16-20
Wisconsin:			
Green Lake	3	14	18
Sheboygan	½	.....	24
Wood	11½	135	16-20

a—On centers; b—total, reinforced and plain.

Concrete Not Reinforced

	Miles Built in 1926	Miles in County, end of 1926	Width of Improved Surface
California:			
Alameda	6.4	46	.....
Sutter	.....	16.1	16
Colorado:			
Kings	.....	2	16
Larimer	.....	1.2	26
Mesa	.....	7½	18
Washington	9	.....	.....
Delaware:			
Sussex	18	120	.....
Illinois:			
Douglas	.....	31	9-16
Iroquois	.....	185	10-18
Jasper	12s	25	30
Kankakee	5	.....	.....
Livingston	1¼	7½	9-18
Peoria	7	76	18
Indiana:			
Grant	.....	5	18
Iowa:			
Dubuque	4½	8	18
Kansas:			
Cherokee	1	7¾	18-28
Cowley	6	9½	18
Douglas	.....	18¼	.....
Geary	.....	10	18
Osage	.....	1	18
Ottawa	.....	12.3	18
Reno	.....	8½	18
Republic	2	2	28
Riley	.....	.2	25
Kentucky:			
Fayette	.....	6½	18
Michigan:			
Calhoun	.....	42	20
Genesee	.....	49	18-20
Kalamazoo	.....	53.7	.....
Schoolcraft	0.7	.....	32
Minnesota:			
Carlton	26	37	18
Dakota	0.8	6.1	18-27
Washington	.....	5	.....
Nebraska:			
Hall	.....	1	.....
Nuckolls	.....	2	.....
New Jersey:			
Mercer	.....	2	18
New York:			
Madison	4	23	10-16
Onondaga	16.3t	.....	.....
North Carolina:			
Perquimans	.....	10	9
Ohio:			
Ashtabula	.....	19.3	.....
Butler	.....	4.2	.....
Hamilton	20	52	20
Jefferson	.....	20	18
Medina	16½	97	9-18
Morrow	.....	12	16-18
Muskingum	1.8	23.7	18
Ottawa	.....	20.6	16-18
Preble	4¾	14	18
Warren	.....	.4	20
Wayne	4	63	10-16
Williams	5	11	14-18
Oklahoma:			
Kingfisher	6.6	12.6	18
Oregon:			
Douglas	1	4	16
Linn	.....	9½	16
Yamhill	.....	6½	16
South Carolina:			
Chester	.....	22	9-16
Tennessee:			
Madison	6	20	18
Washington:			
Clallam	7	.....	.....
Cowlitz	.....	44	9-20
Gray's Harbor	.....	45	18-20
Walla Walla	.....	3.6	18
Wisconsin:			
Dane	28.6	.....	.....
Dunn	9	.....	.....
Fond du Lac	2½	133.3	16-20
Richland	1½	7½	16-20
Sauk	1	10	20
Walworth	3¼	138	18
Washington	5	86	16-20
Wyoming:			
Sheridan—c	.....	11	12-16

S—by state; t—by town; c—city and county.

Brick

	Miles Built in 1926	Miles in County, end of 1926	Width of Improved Surface
Florida:			
Sarasota	1½	1½	18
Illinois:			
Douglas	.....	5½	10
Iroquois	.....	6.4	9
Livingston	.....	6	18
Indiana:			
Grant	.....	4	24
Miami	.....	.8	24
Iowa:			
Black Hawk	.....	4	18
Scott	.....	33½	18
Kansas:			
Butler	.....	19½	18
Chase	½	.....	.....
Geary	.....	3	20
Lyon	.....	1	.....
Reno	.....	53½	18
Riley	1.1	1.1	20
Michigan:			
Calhoun	.....	5.7	18
Kalamazoo	.....	0.7	24-26
Minnesota:			
Ramsey	.....	¼	20
Mississippi:			
Warren	.....	2½	12
Nebraska:			
Lancaster	.....	10	18-30
New Jersey:			
Camden	.....	.4a	.....
Essex	.....	.17	.....
Mercer	.....	.38	24
New York:			
Chautauqua	.....	44.9	16-18
North Carolina:			
Perquimans	.....	16	9
Pitt	.....	6	16
Ohio:			
Ashtabula	.....	92	.....
Butler	.....	14.2	.....
Carroll	.....	1	16
Jefferson	.....	40	18
Lucas	4	7.7	20-36
Marion	.....	7.5	17
Medina	1	11	18-20
Miami	.....	0.2	.....
Morrow	½	½	18
Muskingum	.....	37	16
Ottawa	.....	9	.....
Preble	.....	11	16
Sandusky	5	43	16-20
Ohio:			
Warren	.....	20.1	20.50
Wayne	3½	82½	16-18
Wood	.....	7	20
West Virginia:			
Tyler	.....	1	30
Wisconsin:			
Sauk	.....	4	.....

a—and block.

Graded Roads

	Miles Built in 1926	Miles in County, end of 1926	Width of Improved Surface
Alabama:			
Bullock	200	1,000	18-20
Clarke	10	50	18
Coffee	125	300	30
Crenshaw	100	500	18
Franklin	150	250	12-16
Jackson	30	130	12-18
Arkansas:			
Cleveland	.....	300	20
Dallas	20	325	24
Hot Springs	14	800	40
Phillips	350	500	24
California:			
Alameda	1.8	4	.....
Fresno	.....	4,000	20
Kings	.....	850	40
San Luis Obispo	60	.....	.....
Sutter	.....	35	25
Colorado:			
Las Animas	42	220	24
Larimer	30	687	26
Logan	250	1,800	18
Mesa	21	3,200	18
Washington	15	.....	.....
Delaware:			
Sussex	300	2,100	.....
Florida:			
Collier	26	80	24-30
Santa Rosa	30	200	36
Taylor	23	85	16-25
Georgia:			
Camden	40	.....	.....
Echols	15	15	30
Evans	50	221	30
Polk	6	25	.....
Wilcox	2	.....	.....
Worth	.....	750	26
Idaho:			
Bonneville	.....	135	16
Bonner	2	1,100	25
Franklin	7¼	220	16
Kootenai	6	600	18
Madison	.....	500	50
Orofino	9	.....	.....
Owhyee	.....	400	.....
Power	7	437	22
Shoshone	12	130	24
Illinois:			
Carroll	40	100	30
Champaign	100	1,800	30
De Kalb	2	.....	.....
Douglas	.....	700	28
Effingham	750	1,000	24-30
Fulton	1,000	1,500	24-30
Hancock	.....	.....	30
Jasper	20	45	24-30
Kane	20	.....	15
Lake	10	115	30
Livingston	20	225	46
Menard	450	.....	24
Peoria	8	250	30
Pulaski	5	365	20
Richland	450	.....	24
Sangamon	15	150	28
White	500a	500	.....
Whiteside	7	.....	.....
Winnebago	20	.....	30
Woodford	302	600	24
Indiana:			
DeKalb	15	.....	.....
Martin	.....	22	18
Putnam	.....	688	9-18
White	.....	500	24
Iowa:			
Benton	25	.....	26
Black Hawk	19	60	26
Boone	12	.....	.....
Bremer	.....	40	28
Buchanan	4½	10	28
Calhoun	18	.....	26
Cerro Gordo	7	.....	.....
Cherokee	6½	108	26
Chickasaw	7.8	54	24-26
Clarke	3	1,200	26
Clayton	.....	136	.....
Crawford	24	156	28
Creston	5	30	26
Dallas	43.6	660	24
Decatur	.....	31.6	26
Delaware	8¼	.....	.....
Dickinson	25	.....	.....
Dubuque	.....	.....	26-28
Emmett	36	12	22-26
Fayette	7	136	26
Floyd	16	68	26
Grundy	12	150	24
Hancock	12	12	26
Howard	8	20	26
Jackson	10	34	26-28
Johnson	11.8	16	26
Jones	40	65	.....
Kossuth	65	506	26
Linn	38½	41	.....
Lucas	.....	24	28
Lyon	30	32	26
Madison	12	36	28
Marshall	16.8	18.8	26
Monona	1	.....	.....
O'Brien	11	120	26
Osceola	22	22	26-28
Palo Alto	9	228	24
Plymouth	3	.....	.....
Poweshiek	2	48	.....
Sac	22½	.....	.....
Scott	4.7	139	26
Sioux	22½	.....	26
Story	.....	36	26
Wayne	9.3	45	28
Winneshiek	6.6	.....	.....
Kansas:			
Barber	500	700	20-28
Brown	15	62	26
Butler	7	7	30
Chase	90	500	28
Chautauqua	26	50	28
Cherokee	15	46	26-30
Cheyenne	167	1,469	20-30
Cowley	25	35	30
Douglas	12½	160	28
Ellis	75	129	30
Geary	6½	30	28
Gore	40	1,218	20-28
Haskell	20	150	30

	Miles Built in 1926	Miles in County, end of 1926	Width of Improved Surface
KANSAS (continued)			
Hodgeman	13	.....	28
Jackson	64	174	28
Kingman	1	212	32
Lyon	45	.....	.....
Marshal	3½	3½	28
McPherson	70	.....	.....
Neosho	13	.....	26
Osage	6	25	28
Ottawa	18	62	28
Pawnee	.....	.....	28
Phillips	23	.....	28
Pottawattomie	150	1,738	.....
Pratt	.....	1,260	20-30
Reno	.....	100	28
Republic	200	1,400	.....
Rooks	156	1.060	30
Rush	28	74	30
Sheridan	600	200	28
Thomas	20	1,506	30
Wabaunsee	20	.....	.....
Wallace	64½	260	30
Woodson	25	150	26
Kentucky:			
Butler	5	10	.....
Fayette	.....	15	.....
Floyd	.....	3½	30
Mercer	.....	400	14
Ohio	25	45	.....
Rockcastle	6	45	18
Scott	23	.....	40
Louisiana:			
Beauregard	30	680	20-24
Bogalusa	.....	70	18
Michigan:			
Leelanau	4¾	4¾	24
Manistee	6½	125	16
Mason	6	145	9-18
Schoolcraft	1	.....	.....
Minnesota:			
Aitkin	8	10½	24
Becker	13.8	48	24
Beltrami	15	315	20-24
Benton	12	24	24
Blue Earth	24	.....	24
Big Stone	6.6	23.6	24
Brown	90	.....	.....
Carlton	.....	831	16-24
Carver	15	.....	24
Chippewa	5½	122	24
Clearwater	7	19	24
Cottonwood	100	900	24
Dakota	2.2	2.2	30
Dodge	18.8	24	24
Douglas	29	18	24
Faribault	52	45.4	22
Goodhue	29.8	180	24
Grant	.....	29	.....
Hubbard	.....	11.5	.....
Jackson	18	157	24
Kandiyohi	46½	27½	24
Lac qui Parle	17	27.7	24
Lake	12½	.....	18-30
Le Sueur	28.7	252	24
Lyon	11.3	13.3	24
Marshall	33	213	24
Martin	10	17.9	24
McLeod	16	828	.....
Meeker	35	250	20-24
Morrison	15	.....	.....
Nobles	37	244	24
Norman	15	172	24
Olmsted	3.3	5.3	24
Ottertail	46	90	24
Pipestone	8	8	24
Polk	24.2	179¼	24
Ramsey	12.1	17	20-40
Red Lake	6	35	24
Rice	14	32	.....
Rock	5	5	24
Roseau	8	38½	24
Scott	11	92	24
Sherburne	.....	1	.....
Sibley	24.9	317	24
Stearns	75	.....	16-20
Steele	12½	90	24
Swift	50	1,000	18-24
Todd	7	.....	.....
Wadena	25	175	24
Waseca	24	17	24
Watonwan	26	408	20-24
Wilkin	12	32	24
Wright	25	500	20-24
Mississippi:			
Warren	.....	122	18
Missouri:			
Atchison	.....	.....	30
Boone	.....	800	.....
Butler	200	700	24
Cole	52	.....	.....
Dallas	27	390	30
Daviess	10	600	.....
Holt	4	600	24
Monroe	100	800	18-24
St. Clair	25	120	26
Montana:			
Beaverhead	57	326	24
Carbon	50	1,500	24
Daniels	136	345	20
Gallatin	20.6	945	22-24
Missoula	11	771	18
Petroleum	40	120	22
Ravalli	10	500	20
Rosebud	105	460	22-32
Sheridan	80	530	20
Wheatland	30	720	.....
Nebraska:			
Clay	30	30	.....
Hall	5	.....	.....
Holt	40	3,000	20-24
Knox	100	2,464	24
Lancaster	225	1,700	24-30
Lincoln	232	.....	.....
Nuckolls	.....	14	24
Otoe	300	.....	24
Richardson	8	125	24
Saunders	285	1,345	24
New Jersey:			
Morris	.....	33.5	12
New Mexico:			
Luna	70a	120	18
Rio Arriba	.....	300	10-20
New York:			
Onondaga	6	.....	.....
Oswego	.....	75	28
Steuben	15	.....	16-18
North Carolina:			
Cabarrus	35	190	18
Caldwell	10	.....	18
Gates	14.3	14.3	40
Perquimans	10	30	40
Pitt	10	56	40
Scotland	.....	272	30
Wayne	60	.....	30
North Dakota:			
La Moure	60	280	20
McIntosh	35	135	24
Stutsman	54½	.....	.....
Walsh	15	80	24
Ohio:			
Ashtabula	5.3	5.3	.....
Butler	.....	131	.....
Carroll	2	2	.....
Clark	19	.....	20
Darke	2	.....	.....
Hocking	3	.....	.....
Jefferson	.....	825	.....
Marion	.....	272	.....
Medina	5	20	28
Monroe	5	8	14
Morgan	4	.....	20
Muskingum	10	.....	.....
Pickaway	3	.....	14
Preble	20	.....	18
Richland	3	.....	.....
Sandusky	.....	175	20-26
Warren	.....	204	20-30
Wayne	½	½	.....
Williams	4	.....	.....
Wood	.....	448	.....
Oklahoma:			
Blaine	35	.....	24
Garfield	48	500	32-36
Kingfisher	6½	250	30
Roger Mills	300	500	25
Wagoner	32	50	24
Woods	.....	413	30
Oregon:			
Douglas	15	277	16
Linn	15	1,325	10-30
Yamhill	5	1,100	24
South Carolina:			
Georgetown	59	.....	32
Sumter	65	615	27½
South Dakota:			
Beadle	25	.....	.....
Belle Fourche	25	.....	.....
Davison	20	125	24
Day	53½	.....	24
Douglas	26	180	24
Hutchinson	87	185	24
Lawrence	10	112	24
Lincoln	21	.....	24
McCook	8	.....	24
Roberts	25	25	24
Sanborn	31	.....	.....
Union	32	140	24
Tennessee:			
Henry	300a	350	20
Madison	.....	200	30
Montgomery	147	1,200	16

	Miles Built in 1926	Miles in County, end of 1926	Width of Improved Surface
Texas:			
Armstrong	20	150	20
Castro	50	150	35
Hansford	50	150	28
Mason	23	145	24
Nolan	75b	75	24
Virginia:			
Bedford	40	300	14
Russell	10	50	12
Tazewell	.....	80	.....
Warwick	3	12	22
Washington:			
Adams	16	1,700	.....
Cowlitz	6	642	14-24
Franklin	10	760	.....
Lincoln	50	3,000	24
Pend Oreille	.....	625	.....
Skamania	2	177	12
Walla Walla	2	500	12
Whatcom	21	422	12d
West Virginia:			
Tyler	8	10	26
Wirt	7½	.....	.....
Wyoming	20	100	22
Wisconsin:			
Bayfield	28	287	22
Columbia	3	.....	.....
Dunn	35	.....	.....
Fond du Lac	6	6	.....
Grant	13.5	.....	22
Green Lake	17	.....	24
Juneau	20.8	.....	.....
La Fayette	82	.....	.....
Polk	25	.....	.....
Richland	5	46	26
Sauk	40	50	24
Vernon	37	.....	.....
Washburn	40	782	20
Washington	20	200	24
Waushara	5	10	36
Wood	20	350	18
Wyoming:			
Campbell	88	292	20-24
Natrona	116	375	20
Sheridan c	24.5	747	18-28

a—regrading; b—1925 and 1926; c—city and county; d—and more.

Water-bound Macadam

	Miles Built in 1926	Miles in County, end of 1926	Width of Improved Surface
Alabama:			
Jackson	5	.....	.....
Delaware:			
Sussex	3	.....	12
Illinois:			
Carroll	.....	15	12
Iroquois	.....	15	.....
Kankakee	5	.....	.....
Lake	.....	5	30
Livingston	1	104	9-12
Indiana:			
Carroll	1	.....	.....
Crawford	.....	125	.....
Grant	.....	154	18
Jefferson	.....	267	.....
Huntingdon	.....	122	.....
Martin	.....	113	9
Miami	.....	12.8	12
Putnam	.....	346	.....
Wells	0.8	.....	.....
Kentucky:			
Fayette	1	50	14
Scott	23	460	.....
Michigan			
Huron	5	11	20
Minnesota:			
Olmsted	.....	5	.....
Missouri:			
Pettis	.....	25	16
Montana:			
Galatin	.....	2	18
New Jersey:			
Atlantic	1.2	1.2	.....
Camden	.....	12½	14
Mercer	.....	78.6	14-18
Warren	5.4	5.4	.....
New York:			
Chautauqua	.....	35.9	16-18
Jefferson	.....	184	10
Madison	.....	87	10-16
Onondaga	2.4	.....	.....
Oswego	.....	296	12
Suffolk	.....	4	.....
Steuben	1	.....	16
North Carolina:			
Mecklenburg	2	.....	.....
Ohio:			
Ashtabula	.....	10.7	10-16
Butler	.....	3	.....
Highland	4	18½	14
Jefferson	.....	250	10
Lucas	2	134	10-16
Marion	20	100	14-16
Morrow	.....	25	10-16
Muskingum	.....	18.9	.....
Ottawa	.....	326	9-16
Richland	12	.....	10-18
Sandusky	10	595	10-18
Union	3	.....	18
Warren	11.6	365	16-20
Wayne	.....	3	16
Williams	.....	63	12-18
Wood	7	679	12-16
Oregon:			
Yamhill	10	.....	12-16
Virginia:			
Bedford	4.3	17	14
Russell	8	120	12-30
Tazewell	.....	60	.....
Washington:			
Adams	.....	4.2	20
Asotin	1	60	18
West Virginia:			
Tyler	2	3	14
Wisconsin:			
Waushara	.....	50	.....

A—by Town

Sand-Clay and Top Soil

	Miles Built in 1926	Miles in County, end of 1926	Width of Improved Surface
Alabama:			
Crenshaw	100	100	24
Pike	.....	90	24
Arkansas:			
Hot Springs	10	200	40
Colorado:			
Logan	40	.....	.....
Washington	15	.....	.....
Florida:			
Santa Rosa	.....	50	10-18
Georgia:			
Camden	15	.....	.....
Evans	25	100	30
Worth	20	45	30
Idaho:			
Bonneville	.....	1,088	18
Bonner	.....	100	25
Kootenai	3	15	20
Madison	.....	300	50
Owyhee	.....	300	.....
Iowa:			
Jones	25a	58a	.....
Kossuth	.....	1,000	.....
Marshall	16.2b	67.6b	24
Kansas:			
Anderson	20	.....	28
Barber	4¼	35	28
Butler	4	4	22
Cheyenne	14	14	28
Cowley	10	10	20
Ellis	10	14	.....
Kingman	.....	175	28
Lyon	1	1	.....
McPherson	20	42	20-28
Phillips	3	.....	.....
Pottawatomie	10	25	20
Pratt	.....	95	24-30
Reno	.....	108	28
Rush	21	28	30
Michigan:			
Chippewa	.....	.....	15
Minnesota:			
Aitkin	2	20	24
Becker	6	6.3	24
Carlton	.....	46	18-24
Dakota	13.1	157½	30
Hubbard	.....	62½	24
Kandiyohi	.....	4½	24
Otter Tail	.....	30	24
Ramsey	.....	5	20
Red Lake	.....	1	24
Rice	.....	204	.....
Sherburne	.....	1.5	.....
Wadena	5	20	24
Mississippi:			
Warren	.....	3	.....
Missouri:			
Butler	200	.....	.....
Dallas	24	285	.....
Nebraska:			
Knox	10	40	24
North Platte	24	.....	.....
Otoe	12	70	28

	Miles Built in 1926	Miles in County, end of 1926	Width of Improved Surface
New York:			
Madison	.....	1,100	24
North Carolina:			
Cabarrus	40	.....	.....
Caldwell	15	.....	18
Gates	3	3	40
Mecklenburg	20a	.....	30
Scotland	.....	350	30
Wayne	24	.....	24
Ohio:			
Butler	16	565	.....
Highland	.....	46¾	12
Miami	.....	35	.....
Morrow	.....	650	.....
Muskingum	.....	1,058	.....
Oklahoma:			
Woods	22	37½	24
South Carolina:			
Chester	15	185	26-34
Kershaw	50	800	.....
South Dakota:			
Miner	20	.....	.....
Tennessee:			
Henry	2	.....	.....
Texas:			
Andrews	25	25	60
Virginia:			
Bedford	15	60	18
Dinwiddie	15	300	26
Henry	5	100	18
Mecklenburg	.....	450	.....
Washington:			
Gray's Harbor	.....	61	12
West Virginia:			
Boone	9	300	20
Wisconsin:			
Adams	40	.....	26
Bayfield	5	195	24
Grant	1.9	.....	9
Washington	.....	50	.....
Waushara	.....	50	.....
Wood	4	.....	.....

a—sand-clay and gravel; b—sand-clay, gravel and waterbound macadam.

Gravel

	Miles Built in 1926	Miles in County, end of 1926	Width of Improved Surface
Alabama:			
Bullock	7	25	18-20
Crenshaw	15	15	24
Franklin	40	250	12-16
Jackson	25	.....	.....
Pike	4	4	24
Arkansas:			
Dallas	18	125	.....
Hot Springs	25	250	24
Phillips	2	3	18
California:			
Alameda	.....	263	.....
Fresno	.....	67a	16
Sutter	15	277	12
Colorado:			
Kings	.....	1	25
Lake	.....	71	16-18
Larimer	15	229	26
Las Animas	16	.....	24-26
Logan	35	.....	.....
Mesa	9	55	18
Washington	12	.....	.....
Florida:			
Collier	23	80	24-30
Santa Rosa	.....	2	10
Georgia:			
Worth	.....	5	30
Idaho:			
Bonneville	.....	205	18
Bonner	.....	100	25
Franklin	14	137	16
Kootenai	6b	20b	20
Lewis	12	50	16
Madison	20	108	50
Orofino	3½	.....	.....
Owyhee	.....	100	.....
Shoshone	.....	28	24
Illinois:			
Carroll	8	50	14
Champaign	8	20	10
De Kalb	6	.....	18
Douglas	.....	38	10-16
Grundy	22	.....	.....
Hancock	4	.....	.....
Iroquois	1½	75	14
Kane	20	.....	15
Kankakee	3	.....	.....
Lake	40	160	30
Peoria	30	57	.....
Pulaski	5	185	18
White	28	156	9
Whiteside	17½	.....	.....
Indiana:			
Carroll	13¼	586	.....
DeKalb	55½	254	12-14
Grant	.....	521	18
Huntington	.....	376	.....
Martin	.....	7	9
Marshall	50	370	.....
Miami	9	466	12
Putnam	.....	342	.....
Steuben	33	188	16
Washington	.....	190	.....
White	25	500	24
Iowa:			
Benton	4	.....	26
Black Hawk	16.7	83.5	26
Boone	80	.....	.....
Bremer	14	36	28
Buchanan	16	154	24-28
Buena Vista	76	195	22
Calhoun	60½	.....	.....
Cerro Gordo	23	98	.....
Cherokee	6	22	26
Chickasaw	5	50	.....
Crawford	21	21	28
Dallas	39.6	372	26
Delaware	4½	.....	.....
Dickinson	25	145	24
Dubuque	23	40	28
Emmet	22½	189	22-28
Fayette	2½	82	26
Floyd	22.7	63.6	24
Grundy	25	90	20
Hancock	19	45	20
Howard	3½	7	.....
Jackson	12	12	26
Johnson	2.7	5	20
Kossuth	81	415	26
Linn	36	75	.....
Lyon	9	113	26-28
O'Brien	4	20	26
Osceola	27	79.7	26
Palo Alto	37	174	24
Plymouth	8.0	.....	.....
Pocahontas	40	273	22-26
Powesheik	.....	42	24
Sac	34½	.....	.....
Scott	4.7	30	20
Sioux	7	.....	26
Story	18½	175	24
Wienneshiek	11.6	15½	.....
Kansas:			
Butler	.....	6½	22
Chautauqua	.....	1	28
Cherokee	15	118	26-30
Cowley	10	10	18
Haskell	.....	2	.....
Jackson	2	.....	.....
Lyon	16	17	19
Neosho	.....	45	24
Pottawatomie	4	10	20
Rooks	.....	2	.....
Thomas	3.7	.....	.....
Wabaunsee	.....	3	16
Kentucky:			
Ohio	1½	.....	16
Louisiana:			
Beauregard	13	61	9
Bogalusa	20	.....	.....
Jefferson	30	.....	18
Michigan:			
Allegan	21	250	9-16
Branch	26.6	295	9
Calhoun	14	361	9
Cass	6½	215	9-16
Chippewa	.....	4	.....
Genesee	17	497	15
Huron	18	450	9
Isabella	4	.....	9
Jackson	25	368	9
Kalamazoo	14.9	237	24-26
Leelanau	10¾	125	9-16
Livingston	8	275	9-16
Manistee	10	125	16
Mason	3	.....	.....
Shiawassee	12	280	16
Minnesota:			
Aitkin	10½	10½	24
Becker	3½	19.4	22
Beltrami	5	.....	.....
Benton	13	82.6	24
Big Stone	6	51.1	24
Blue Earth	24	.....	20
Brown	143	.....	.....
Carlton	.....	326	18-24
Carver	12	.....	24-32
Chippewa	17	106	24
Chisago	14½	123.6	24
Clearwater	.....	15.4	.....
Cottonwood	60	186	20
Dakota	1	41.6	.....

	Miles Built in 1926	Miles in County, end of 1926	Width of Improved Surface
Minnesota (Continued)			
Douglas	28.6	130.4	24
Faribault	60.2	77.6	20
Goodhue	37.2	161	24
Grant	.....	96	.....
Hubbard	.....	17.5	.....
Jackson	20	139	22
Kandiyohi	55½	131	24
Sacqui Parle	.....	142.3	.....
Lake	12½	400	18-30
Le Seuer	15½	.....	.....
Lyon	11½	182½	24
Marshall	35	155½	24
Martin	2	158	24
McLeod	39	.....	24
Meeker	32	230	20-24
Morrison	15	.....	.....
Nobles	6.3	195	.....
Olmsted	22½	110	24
Otter Tail	2	160	24a
Pipestone	9	93	20
Polk	17¾	94¼	24
Ramsey	11	167.3	20-30
Red Lake	1½	56	24
Rice	7	286	.....
Rock	13	114	24
Roseau	10	31.3	24
Scott	10	92	24
Sherburne	6½	62	24
Sibley	36.6	283	.....
Stearns	50	.....	.....
Steele	7.2	77	22
Swift	15	140	20-24
Wadena	48	60	.....
Waseica	19	121	24
Washington	4.8	69	24
Watonwan	33	233	20
Wilkin	18.8	51.2	24
Wright	25	500	18-20
Mississippi:			
Warren	4.6	98.4	18
Missouri:			
Cole	15	.....	.....
Dallas	3	195	.....
Daviess	5	15	20
Pettis	6½	140	9-16
St. Clair	15	.....	.....
Montana:			
Beaverhead	12	45	24
Carbon	10	.....	.....
Gallatin	6	56.4	16-18
Missoula	6	66	18
Ravalli	2	.....	.....
Wheatland	1	10	.....
Nebraska:			
Clay	18	.....	.....
Hall	38	142	.....
Knox	20	32	24
Lancaster	18	100	24-30
Lincoln	10	.....	.....
Nuckolls	.....	77½	24
Richardson	26	26	24
New Jersey:			
Camden	.....	49.7	30
Mercer	.....	7.3	20
Morris	.....	5.8	16
New Mexico:			
Rio Arriba	.....	100	18-20
New York:			
Chautauqua	.....	9.7	16-18
Essex	26	194	12
Onondaga	23.5c	.....	.....
Oswego	.....	278	9
Suffolk	.....	1,102	.....
Steuben	3	.....	16
Yates	4.8	.....	30
North Carolina:			
Caldwell	5	.....	18
North Dakota:			
La Moure	20	90	40
McIntosh	5	.....	.....
Stutsman	30½	63½	24
Ohio:			
Ashtabula	.....	68	10-16
Clark	30	.....	20
Darke	5	985	12
Hamilton	2	.....	16
Highland	5	84	12
Hocking	18	.....	18
Jefferson	6½	6½	16
Marion	.....	84.4	15
Medina	.....	2.6	12
Miami	4	760	.....
Monroe	6e	8	14-16
Morgan	9	13	12
Muskingum	30	87	.....
Pickaway	3	700	.....
Preble	25	170	18
Richland	15	.....	14
Warren	.....	168	14-16
Wayne	11	23	16-18
Williams	17	44	10-18
Oklahoma:			
Blaine	4	9	18
Craig	215,000s	.....	.....
Garfield	28	54	18
Kingfisher	• ½	½	18
Wagoner	.....	61	24
Woods	3	3	24
Oregon:			
Douglas	10	700	16
Linn	20	600	10-30
Yamhill	20	.....	12-16
South Carolina:			
Sumter	.....	6½	16
South Dakota:			
Belle Fourche	5	.....	.....
Davison	6	.....	.....
Day	24	.....	.....
Hutchinson	4	73	24
Lawrence	9	27½	24
Lincoln	2	.....	.....
McCook	3½	.....	.....
Miner	17	.....	.....
Sanborn	19	.....	.....
Union	19	83	24
Tennessee:			
Henry	5	.....	.....
Madison	.....	60	18
Montgomery	50	470	12
Texas:			
Mason	10	50	40
Nolan	12	12	.....
Virginia:			
Bedford	5	5	18
Russell	7	15	12
Warwick	3	49	22
Washington:			
Adams	19½b	312½b	18
Clallam	28	500	16-24
Cowlitz	.....	126	16
Douglas	4	85	24
Franklin	15b	207	.....
Gray's Harbor	11	597	16-20
Lincoln	36	215	16
Pend Oreille	3	80	24
Shamania	2	15	12
Walla Walla	23	247	12-18
Whatcom	12	252	12-20
West Virginia:			
Boone	13	.....	.....
Tyler	4	14	18
Wisconsin:			
Adams	9	.....	18
Bayfield	8	76	24
Columbia	57	550	9-26
Dane	78.2	.....	20-24
Dunn	10	.....	.....
Fond du Lac	35.3	213.4	16
Grant	74.3	.....	15
Green Lake	19	80	9-16
Juneau	2	.....	.....
Lafayette	58	.....	.....
Polk	45	.....	.....
Richland	7½	38.2	24-26
Sauk	20	300	.....
Sheboygan	25½	.....	26
Vernon	1.8	.....	.....
Walworth	14½	200	24
Washburn	4	20	26
Washington	20	150	24
Waushara	13	200	20
Wood	4	.....	.....
Wyoming:			
Natrona	12	12	20
Sheridan—d	.....	47	24

a—Oiled; b—crushed rock; c—by town; s—sq. yards; d—city and county; e—gravel and slag.

Special Kinds

In addition to the pavements listed in the tables appearing in this issue, the following special pavements are reported as laid in 1926:

Amiesite—Morris Co., N. J., 3½ miles; Marion County, Ohio, 1.32 miles.

Clay-slag—De Soto Co., Fla., 53 miles.

Lime rock and slag—Putnam Co., Fla., 15 miles.

Tarvia—Kankakee Co., Ill., 5 miles.

Industrial Waste—Carroll Co., Ohio, 6 miles.

Shale—Richland Co., Wisc., 3 miles.

Sheet Asphalt—Mercer Co., N. J., 1 mile, 20-36 ft. wide; Lucas Co., Ohio, 1 mile, 20-36 ft. wide.

Kentucky Rock Asphalt—Marion Co., Ohio, 3 miles.

Recent Legal Decisions

BARRIER HELD NOT REQUIRED AT JUNCTION OF DETOUR WITH HIGHWAY

In an action for injuries to an automobilist when his car, traveling 20 miles an hour, made a sudden turn to the right on a road he knew to be under construction and ran into a ditch, the Wisconsin Supreme Court held, Buckley v. Washington County, 207 N. W. 558, that the county and its contractor constructing a detour were not negligent in failing to maintain a barrier at the junction of the old and new highways where nearly 2,000 cars a day passed without difficulty at that point. In any event, it was held, the plaintiff was guilty of contributory negligence as a matter of law, "Contractors and the public authorities are not insurers of the safety of travelers, and the plaintiff under the circumstances disclosed by the facts in this case, was bound to exercise care for his own safety."

UNGUARDED STONE HEAP—SUFFICIENCY OF WARNING

The New Jersey Court of Errors and Appeals holds, Sadlou v. Jannarone, 132 Atl. 749, that a highway contractor cannot escape liability for injury to cyclists by collision with a pile of unguarded stones under the claim that he was performing a public work, and therefore liable only to the board of freeholders for derelictions arising therefrom.

Whether the cyclists, in view of the existing lights in the vicinity, should have observed the dangerous situation, was held a question for the jury. A warning at the entrance of the road notifying the traveler that he might use it at his own risk, was, in effect, a warning to use reasonable care in its use, and whether this was exercised was also a question for the jury.

ROADMASTER'S DISCRETION AS TO THE ORDER OF GRADING UNDER CONTRACT

In an action by a grading contractor on quantum meruit, after his abandonment of the contract, it appeared that in the notice to contractors it was provided that the "probable order of work" would "begin at station 86 plus 72 and finish south to station 63 plus 20, then begin at station 106 plus 50 and finish south to station 86 plus 72." In the contract, however, it was provided that "all work shall be prosecuted in the order outlined by the county roadmaster." The Oregon Supreme Court held, Feldschan v. Clatsop County, 244 Pac. 528, that the discretion thus vested in the roadmaster must be exercised in a fair, honest, and reasonable manner. In every contract there is an implied undertaking on the part of each party that he will not intentionally do anything to prevent the other party from carrying out the agreement on his part. Broad as the roadmaster's powers were under this contract, his decisions, it was held, were binding on the contractor only when free from bad faith and not the result of gross or palpable mistake. If the manner in which the work was directed and supervised was so unreasonable and arbitrary as to imply bad faith, and, as a result thereof, the plaintiff was prevented from performing his contract and was obliged to abandon it, he would be entitled to recover the reasonable value of his work performed and materials furnished. Whether the roadmaster did exercise fair, reasonable and honest judgment in determining the order in which the work should be prosecuted was a question of fact for the jury to determine if evidence should be offered tending to establish plaintiff's alleged cause of action.

ORDINANCE REQUIRING ANTI-COMBINATION AFFIDAVIT WITH BID

The Oklahoma Supreme Court holds, McGrath v. Oklahoma City, 244 Pac. 764, that where an abutting owner seeks to avoid the payment and enjoin the collection of a special assessment against his property for paving, and alleges that the paving contract was void because the successful bid was not accompanied by an anti-combination affidavit, as required by ordinance, he assumes the burden of establishing this allegation by a preponderance of evidence. Under the state statute. Comp. Stat. 1921, Sec. 4619, such an action must be instituted within 60 days from the passage of the ordinance making the assessment.

EVIDENCE OF AMOUNT OF ROCK REMOVED UNDER SUBCONTRACT

A contract between a road contractor and a subcontractor to remove dirt and rock from a highway referred to the contract between the contractor and the highway commission, in which the estimate of the state engineer was to be accepted as conclusive. Final estimates showed that the subcontractor had removed 2,176 cubic yards of rock. In an action by the subcontractor against the contractor the question was as to the quantity of rock moved. The resident engineer testified, as witness for the defendant, that the plaintiff had removed no rock. The Oregon Supreme Court held, Hanson v. Johnson Contract Co., 244 Pac. 875, that it was proper to permit the plaintiff to read letters from the state engineer's office as part of cross-examination to test the credulity and accuracy of the witness, particularly as to that part of his testimony which contradicted the final estimates based on his report.

AGREEMENT TO FURNISH CAPITAL TO ROAD CONTRACTOR DOES NOT CONSTITUTE A PARTNERSHIP

The Kentucky Court of Appeals holds, Roy C. Whayne Supply Co. v. McGowan, 280 S. W. 491, that an agreement to furnish the capital to a road contractor in return for one-half of the net profits of a specified road project was not a partnership, but a mere loan, especially as the lender was not to suffer any part of the losses if there were any.

FILLING STATION GAS ARM NOT A VIOLATION OF AN ENCROACHMENT ORDINANCE

The public easement in a highway includes all reasonable modes of travel and transportation not incompatible with the proper use of the highway by others. It is not restricted to the transportation of persons or property in movable vehicles, but extends to every method of conveyance within the general

purpose for which highways are designed. This does not mean, however, that the public right may be exercised without restraint. The legislature may limit and control it and authorize city councils to pass any ordinance in respect thereto not repugnant to the Constitution and laws of the state. The New Hampshire Supreme Court holds, State v. Scott, 132 Atl. 685, that the use of a gas arm swung over a sidewalk by the owner of a filling station was not a violation of Laws and Ordinances of Manchester of 1924, c. 16, § 16, which is a building ordinance dealing with signs, awnings, and other encroachments. While the city has general as well as special statutory authority to regulate "traffic and travel," it has not attempted to deal with traffic handled by devices like the gas arm.

CHANGE OF ROUTE OF ROAD UNDER CONSTRUCTION—ADDITIONAL COMPENSATION

In an action by a road contractor for additional compensation caused by change of route made after he had entered upon his contract, the question was whether the defendant board of county commissioners made a supplemental contract with the plaintiff. The North Carolina Supreme Court held, London v. Board of Comrs. for Yancey County, 136 S. E. 356, that, in order to make a valid and binding contract, the commissioners must have acted in their corporate capacity in a meeting duly held as prescribed by law, and the evidence was uncertain on this point. If the board were duly assembled and made the alleged agreement with the plaintiff, or if it authorized its chairman or any person to give a letter of instructions directing the work to be changed, and agreeing to pay a fair compensation therefor the plaintiff would be entitled to recover the amount allowed. On appeal by the board from judgment for plaintiff the cause was remanded for specific findings of fact on this point.

ROUTE FOR HARD SURFACING OF ROAD APPROVED BY COMMISSIONERS CANNOT BE CHANGED ON NEW PETITION

Where county commissioners have allowed a petition for the hard surfacing of a road over a definite route, making the appropriate findings and orders, the Kansas Supreme Court holds, State v. Board of Comrs. of Leavenworth County, 245 Pac. 1051, that they cannot, upon the strength of a new petition, make a substantial change in the route. They have no authority to abandon a part of the route because federal aid cannot be obtained therefor. A provision in the petition that the improvement shall be made in accordance with plans approved by the Secretary of Agriculture if federal aid is granted, is held to make such approval necessary for only such portion of the road as receives federal aid.

UNREASONABLE IMPOSITION OF COST OF WIDENING STREET

The Kansas Supreme Court holds, Engstrom v. City of Wichita, 245 Pac. 1033, that where a city appropriated part of a small parcel of land to widen a city street, the erection of a benefit district to pay the total cost of the improvement, which district was exclusively comprised of the remainder of the small tract of land, subjected to diminution by the condemnation proceedings, was prima facie unreasonable, warranting injunction against further proceedings.

MATERIAL MAN'S DUTY TO SEE THAT STATUTE AS TO PUBLIC WORKS CONTRACTOR'S BOND IS COMPLIED WITH

The Oklahoma Supreme Court holds Frensley Bros., Lumber Co. v. Scott, 245 Pac. 615, that one who sells material to a contractor for the erection of a schoolhouse is charged with knowledge of the contractor's statutory duty to give such bond as is required by Okla. Comp. St. 1921 §7485, and that the bond must be filed as required by §7487; and if he sells such contractor material before such bond has been given, he does so at his peril, and if he sustains a loss, he cannot recover damages from the school district in which the building was erected, the proximate cause thereof being his own negligence in not seeing that the statutory requirements had been complied with.

SEWER CONTRACT NOT VITIATED BY INCREASE OF ENGINEER'S ESTIMATE NOT KNOWN TO CONTRACTOR

The Oklahoma Supreme Court holds City of Bartlesville v. Riggs, 245 Pac. 603, that a city engineer's increase of the estimate of the cost of a sewer to allow probable discount on the sewer warrants, the increase not being shown on the face of the estimate, and the contractors having neither notice nor knowledge of such increase, was insufficient to avoid the contract in a suit by taxpayers to set aside the ordinance assessing their property for the improvement.

The city having accepted the contractors' bid, the price in which was within the city engineer's estimate, the bid and letting thereon, in the absence of fraud or collusion, was not subject to attack for want of sufficient bids.

MUNICIPALITY MAINTAINING ELECTRIC LIGHT SYSTEM HELD LIABLE FOR NEGLIGENCE

In an action for damages for death of a pedestrian who came in contact with an uninsulated guy wire of defendant city's electric transmission line, the Nebraska Supreme Court holds that "it is no part of the duty of a municipal corporation to engage in a purely business or commercial enterprise. When it seeks and obtains from the Legislature permission to engage in such an enterprise, its act in so doing is entirely voluntary on its part, and while engaging in such business, it is acting in a purely private business capacity, outside of its functions and duties as a municipal corporation, and is bound by all of the rules of law and procedure applicable to any other corporation or person engaged in a like enterprise."

DAMAGE FROM CASTING SAND AND DIRT ON PLAINTIFF'S PROPERTY

In an action for damages to plaintiff's property caused by the deposit thereon of sand and dirt coming from a natural ravine on a school district's property, which the defendant, the village and the district, filled into the ravine knowing that the rain would wash it upon the adjoining property, the Minnesota Supreme Court held, Bohrer v. Village of Inver Grove, 207 N. W. 721, that the defendants were liable for the damage done.

NEWS OF THE SOCIETIES

May 2-4—NATIONAL CONFERENCE ON CITY PLANNING. Annual conference at Washington, D. C.
May 9-12—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting at Chicago, Ill.
May 12-13—LEAGUE OF TEXAS MUNICIPALITIES. Annual convention at San Angelo, Texas.
May 26-28—TOWN PLANNING INSTITUTE OF CANADA. Annual meeting at Vancouver, B. C.
June 4-6—CONFERENCE OF STATE SANITARY ENGINEERS. Annual meeting at Chicago, Ill.
June 6-8—AMERICAN ASSOCIATION OF ENGINEERS. Annual convention at Tulsa, Okla.
June 6-10 — NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention and exhibition at Atlantic City, N. J.
June 6-11 — AMERICAN WATER WORKS ASSOCIATION. 47th annual convention at Chicago, Ill.
June 6-11—U. S. GOOD ROADS ASSOCIATION. Annual meeting at Savannah, Ga.
June 13—CANADIAN PUBLIC HEALTH ASSOCIATION. Annual meeting at Toronto, Can.
June 20-24—AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting at French Lick, Ind.
June 27-30—SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Annual meeting at Oreno, Me.
Aug. 16-19—INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Annual convention at Salt Lake City, Utah.
September—CITY MANAGERS ASSOCIATION. Fourteenth annual convention, Dubuque, Ia.
Nov. 7-9—NORTH CAROLINA SECTION, AMERICAN WATER WORKS ASSOCIATION. Annual meeting at Durham, N. C.
Nov. 14-18—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Thirty-third annual convention at Dallas, Tex.
Nov. 28-Dec. 2—ASPHALT PAVING CONFERENCE. Sixth annual conference at Atlanta, Ga.
Jan. 9-14—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual convention and road show at Cleveland, O.

NEW JERSEY SEWAGE WORKS ASSOCIATION.

The 12th annual convention of the New Jersey Sewage Works Association was held at the State House, Trenton, March 25, with more than 160 members and visitors attending.

The meeting began with an inspection trip to the new Trenton sewage treatment plant, after which luncheon was served at the Sterling Hotel. Abram Swan, Jr., commissioner of public works of Trenton, delivered an address of welcome.

At the afternoon session, P. N. Daniels, sanitary engineer of Trenton and in charge of the treatment works, gave a brief description of the plant, which cost approximately $1,240,000. The present flow of sewage is 20 million gallons per day, but the plant will handle up to 33 million gallons. Sludge storage of 1.98 cu. ft. per person is provided, and there is .67 sq. ft. area per capita of sludge drying beds.

D. C. N. Collins, in a paper on "Reduction of Ground Water Infiltration," recounted the work accomplished at Cranford in reducing the amount of storm and ground water entering the sewers. The work done included a complete survey of the sewer system, cleaning, repairs where possible, check-ups on private lines, cellar drains and roof connections, and repairs of leaky manholes. By the construction of drains and storm sewers the ground water level was lowered, thus reducing still further the flow of water into the sewers. This campaign has become an annual event, at a cost of $800 to $1,200. The paper was discussed by Wellington Donaldson and H. M. Beaumont.

In a paper on the "Effect of Laundry Wastes on a Small Sewage Disposal Plant," I. R. Riker, senior sanitary engineer of the New Jersey Bureau of Engineering, described the experiences at the Oaklyn, N. J., plant where a large laundry contributed 75,000 gallons or more per day of laundry wastes stronger than sewage to the sewers in which the total flow did not exceed about 150,000 g.p.d. As a result of these wastes, the plant effluent became exceedingly foul, especially during the first part of the week, when the laundry flow was heaviest. Little purification was accomplished by the plant. When the laundry wastes were excluded from the plant, the plant improved rapidly and produced a good effluent.

The Raleigh Avenue sewage screening plant at Atlantic City, N. J., was described by Chester G. Wigley, chief engineer of the Atlantic City Sewerage Co. A feature of this plant is the use of a large diameter screen, which is made necessary by the rise and fall of the tide. Screening is done only while the tide is out or running out. He stated that about 20 per cent. more solids were removed than with a bar screen.

After a description of the operation of the Merchantville-Pensauken treatment plant by R. G. Case, superintendent, and discussion by Dr. Willem Rudolfs, M. J. Blew, and George Catlett, officers were elected as follows:

President, P. N. Daniels, Trenton, 1st vice-president, Asher Atkinson, New Brunswick; 2nd vice-president, Chester G. Wigley, Atlantic City; secretary, John R. Downes, Bound Brook; treasurer, R. W. Lindsey, Lyndhurst.

Following the election of officers, there were reports of officers and committees. It was voted to publish the proceedings quarterly instead of annually as at present. Committee reports were read and discussed, the discussion being led by Dr. Willem Rudolfs. After adjournment for supper, the round table discussion was continued at an evening session.

NEW YORK SECTION, AMERICAN WATERWORKS ASSOCIATION.

A meeting of the New York Section, American Waterworks Association, will be held at Oswego, N. Y., May 5 and 6. E. D. Case, the Pitometer Co., 50 Church St., N. Y., is section secretary.

ASPHALT PAVING CONFERENCE.

The sixth annual Asphalt Paving Conference will be held at the Atlanta-Biltmore Hotel, Atlanta, Ga., during the week of November 28. The Association of Asphalt Paving Technologists will cooperate in holding a joint conference. J. S. Helm of the Standard Oil Co. is president of the Asphalt Association under whose auspices the meeting will be held. Hugh Skidmore is president of the Association of Asphalt Paving Technologists.

ASSOCIATED GENERAL CONTRACTORS

New York State Highway Chapter.

At the first annual meeting of the New York State Highway Chapter of the Associated General Contractors, held at Syracuse, N. Y., March 15, officers were elected as follows: William L. Collins, of Hornell, president; Harry W. Patterson, of Hornell, vice-president; Richard Hopkins, of Albany, secretary and treasurer. The following regional directors were appointed: Albany, Louis Mayersohm, of Albany; Utica, Fred Davis, of Utica; Syracuse, Edward Brayer, of Auburn; Rochester, Frank Collins, of Rochester; Buffalo, E. P. Forestal, of Buffalo; Hornell, John H. Bolton, of Watkins; Watertown, James Haynes, of Watertown; Poughkeepsie, David Schoentag, of Saugerties; Binghamton, Owen P. Williams, of Bainbridge; Long Island, R. W. Smith, of Huntingdon.

Among the speakers at the banquet in the evening were Arthur W. Brandt of the New York State Highway Commission, and Col. W. M. Acheson, engineer of the Syracuse Division, State Department of Highways.

Southern California Chapter.

Officers of the Southern California Chapter have been elected as follows: C. E. Bressler, Santa Ana, president; Ford J. Twaits, Los Angeles, vice-president; E. A. Irish, Los Angeles, secretary; J. F. Hall, treasurer. The board of directors include, K. R. Bradley, chairman; K. P. Lowell; O. C. Struthers, George Hess, W. Jay Burgin, and Charles V. Heuser.

Cincinnati Chapter.

The first annual meeting of the Cincinnati Chapter was held March 15, with Edward J. Harding, membership manager of the national organization, as speaker.

Election of officers resulted as follows: William Miller, president; Eugene Wagner, vice-president; Harry T. Evans, secretary; David G. Devore, treasurer; Irwin Penker, Robert D. O'Connell and M. F. Quill, directors.

A. J. Brehm, retiring president of the chapter, gave a report of activities since organization last year, as did also J. E. Hodges, president of the Building Construction Division, G. E. Jones, president of the Public Works Division, and C. F. Waltz, executive secretary of the Chapter.

Spokane Chapter.

Newly elected officers of the Spokane Chapter are: President, O. J. Amberg; vice-presidents, W. A. Byers and S. G. Morin; managing secretary, Thomas W. Neill; secretary, A. P. Mitchell; directors, W. A. Byers, S. G. Morin, C. L. Muller, T. A. Huetter, and J. W. Lawlor.

MARYLAND WATER AND SEWAGE PLANT OPERATORS.

The First Annual Conference of the Maryland Water and Sewage Plant Operators was held in Baltimore April 21 and 22 with an attendance of 154. The first day was devoted to water treatment and the second to sewage treatment. A permanent association was formed and the following officers elected: President—Abel Wolman, chief engineer, State Dep't. of Health; 1st vice-president—F. H. Dryden, chief engineer, Salisbury Water and Sewer Commission; 2nd vice-president—C. A. Hechmer, department engineer, Washington Suburban Sanitary Commission; treasurer—James V. Cannen, chemist, Hagerstown Water Board; secretary—T. C. Schaetzle, senior assistant engineer, State Dep't. of Health.

The Baltimore filtration and sewage treatment plants were inspected and demonstrations given of the laboratory control tests for rapid filter operation and of control tests in sewage treatment.

Several papers were read and discussed, of which abstracts will be given in our next issue.

PERSONAL

A. J. Sproles for 28 years superintendent of the Greenwood, S. C., water and light plant, died February 23, after a long illness. Mr. Sproles, who was very widely known throughout waterworks circles in the southeast, was formerly president of the Tri-state (afterwards the Southeastern) Water and Light Association.

R. T. Jacobsen has resigned as city engineer of Fargo, N. D., to become assistant editor of the Engineering News-Record, New York.

H. C. Frahm, formerly state engineer of North Dakota, has been appointed chief engineer of the N. D. State Highway Commission.

G. W. Hoffman, formerly senior inspector in the Pennsylvania State Highway Dept., will be located at Denver, Colo., as junior highway engineer with the U. S. Bureau of Public Roads.

J. S. Whitehurst has been appointed city engineer of Lake Wales, Fla., succeeding J. W. Turner.

Philip E. Bond has been appointed city engineer of Holyoke, Mass. Mr, Bond, who held this position some years ago, succeeds J. M. Myers.

J. V. Joyce has been appointed engineer of Pacific County, Wash.

F. M. Plake, formerly assistant to the chief engineer, has been appointed chief engineer of the Missouri Public Service Commission, succeeding James L. Harrop, who has resigned.

S. Frank Nolan has been appointed city engineer of Providence, R. I. Mr. Nolan was formerly maintenance superintendent of the waterworks system.

Louis E. Cote has been appointed chief engineer of the Marine and Fisheries Department, Ottawa, Canada.

Montgomery B. Case, formerly senior resident engineer in charge of construction of the Philadelphia-Camden bridge, has been appointed engineer of construction for the new bridge to be built over the Hudson River at Fort Lee.

CIVIL SERVICE EXAMINATIONS

Junior Patent Examiner. Applications received to May 14. To fill vacancies in the Patent Office at Washington and positions requiring similar qualifications. Entrance salary $1,860 a year. Advancement after a probationary period of six months depends upon individual efficiency, increased usefulness, and occurrence of vacancies. Examination will be given in the optional subjects of civil engineering, electrical engineering, mechanical engineering, chemical engineering, electrochemistry, and general chemistry. The duties are to perform elementary scientific or technical work in the examination of applications for patents; to examine patents and to investigate patents already granted in the United States and various foreign countries. Competitors will be rated on physics, mechanical drawings, technics, the optional subject chosen, mathematics, and French and German.

Principal architectural draftsman, senior architectural draftsman: Applications received to May 17. Entrance salaries, $2,100 and $1,860, respectively To fill vacancies in the Departmental Service, Washington, D C, including Supervising Architect's Office, Treasury Department and Veteran's Bureau. The duties of principal architectural draftsman, under general supervision, are to perform difficult free-hand or architectural drawing and related work, requiring judgment, skill, and a working knowledge of the architectural profession in expressing ideas and data in drawings, or to supervise the work of a number of draftsmen of lower grade The duties of senior architectural draftsman, under supervision, are to perform free-hand or architectural drawing and related work requiring some skill and a working knowledge of architecture in expressing ideas and data in drawings Competitors will not be required to report for examination at any place, but will be rated on specimens of drawing and lettering to be filed with the application, and their education, experience, and fitness.

Junior Engineer: Applications to May 14. Entrance salary, $1,860. Assembled examinations about ten days after close of receipt of applications. To fill vacancies in various branches of the service throughout the United States. Examination will be given in the optional subjects of aeronautical engineering, chemical engineering, civil engineering, electrical engineering, mechanical engineering, mining engineering, naval architecture and marine engineering and structural steel and concrete engineering. The duties consist of such work as routine testing, inspection of engineering material, drawing up plans for minor projects, preparing specifications for engineering material or apparatus, performing field work, making computations, preparing maps, assisting in conduct of experimental research tests, compiling reports and handling technical correspondence. Competitors will be rated on general physics, mathematics, general engineering, and the optional subject chosen.

Assistant Structural drattsman, structural draftsman, senior structural draftsman: Applications received to May 17. To fill vacancies in Department Service. Entrance salaries, $1,500, $1,680 and $1,860. The duties will be to make simple layout or general drawings or to develop detail drawings in accordance with drawings showing layout or general design of structural work; to take data from notes, maps, or computations; to prepare drawings for various types of structural work, taking data from such work, drawings or sketches; to make routine technical computations and calculations; to make routine estimates; and to perform related work as required. The degrees of responsibility and the difficulty of the work depends upon the grade of position to which assigned. Competitors will be rated on their education, experience, and fitness; and a specimen of drawing and lettering to be filed with the application.

MUNICIPAL AND OTHER PUBLIC REPORTS

Marinette County, Wisc. Fifteenth annual report of County Highway Commissioner. 1926. 32 pages.

State Highway Commission of Maine. Twelfth and thirteenth annual reports Jan. 1, 1924, to June 30, 1926. 160 pages.

Hardness and Tensile Strengths of Metals. The Bureau of Standards has just issued Technologic Paper No. 334, in which is given the relation between the results obtained by two generally used methods of measuring the hardness of metals. The Brinell and Rockwell methods have been compared and semi-experimental formulas derived whereby the hardness number of either can be computed from the other with an error of less than 10 per cent. Similar formulas were obtained for tensile strength, which can be computed from the Rockwell hardness number within an error of 15 per cent.

Grit Chambers and Sewage Screens. By Howard R. Green, 8pp., Ill. Engineering Extension Department, Iowa State College, Ames, Ia. Presented at the eighth conference on sewage treatment at Ames, Ia.

Fourth Annual Short School, Texas Association of Sanitarians. 155 pages. Complete proceedings, including over 30 pages and discussions in seven sections, I. Aims and Objectives of the Association; II. Organization; III. Public Health Education; IV. Waste Disposal and General Sanitation; V. Food Protection; VI. Water Supplies; VII. Disease Control Procedure.

(Continued on page 46)

NEW CATALOGS

ASPHALT BOOKLETS.
The Texas Co., New York, N. Y. Useful information on each of the following types of road and street improvements is presented in illustrated booklets: Sheet Asphalt, Asphaltic Concrete, Asphalt Macadam, Asphalt Filler for Brick Paving, Road Oil and Surfacing Material, Cold Patch, Resurfacing Worn Macadam and Gravel with Asphalt, Resurfacing Worn Brick and Block with Asphalt.

AUSTIN WESTERN LINE.
Austin-Western Road Machinery Co., Chicago, Ill. An elaborate and well-illustrated 52-page catalog covering simply and clearly the essential and important features of this line of road making equipment.

INSLEY MANUFACTURING CO.
Insley Manufacturing Company, Indianapolis, Indiana. A 64-page catalog with many illustrations showing the various products of the company engaged on many varieties of work.

GENERAL EXCAVATOR CO.
General Excavator Co., Marion, O. An 8-page illustrated catalog describing the General Excavator.

SCHRAMM AIR COMPRESSORS
Schramm, Inc., West Chester, Pa. An elaborate illustrated 32-page catalog describing Schramm air compressors, and illustrating their adaptability to various kinds of work.

KOEHRING MIXERS
Koehring Co., Milwaukee, Wis. Illustrated folder describing the Koehring paving mixer.

McCACKEN PIPE MACHINES
McCracken Machinery Co., Sioux City, Ia. A 24-page illustrated catalog describing the McCracken machine for making concrete pipe.

CHAUSSE OIL BURNER CO.
Chausse Oil Burner Co., Elkhart, Ind. A 20-page illustrated catalog describing Chausse Equipment for repairing asphalt pavements, and also oil burners and other road equipment.

BOSS PAVERS AND MIXERS
American Cement Machine Co., Inc., Keokuk, Ia. 24-page illustrated catalog of Boss mixing, paving and hoist equipment.

BARBER-GREENE DITCHER
Barber-Greene Co., Aurora, Ill. A 32-page well illustrated catalog showing the Barber-Greene ditcher engaged in many kinds of ditching work.

STROUD ELEVATING GRADERS AND DUMP WAGONS
J. D. Adams & Co., Indianapolis, Ind. An illustrated 24-page catalog of Stroud elevating graders and dump wagons, giving complete description and specifications.

INGERSOLL-RAND PORTABLE AIR COMPRESSORS
Ingersoll-Rand Co., New York. The fifth edition of a very elaborate and complete catalog, containing 112 pages and many illustrations devoted to the detailed description, with rather complete comparative cost data, of 101 ways to save money by the use of portable air compressors.

CLETRAC CRAWLER TRACTOR
Cleveland Tractor Co., Cleveland, O. 16-page illustrated catalog describing the Cletrac 20-K and the Cletrac 30-A, with specifications.

HIGHWAY SIGNS AND MARKERS
The Western Stamping and Manufacturing Co., St. Paul, Minn., and Cleveland, O. An elaborately illustrated 44-page catalog showing many types of highway signs and markers.

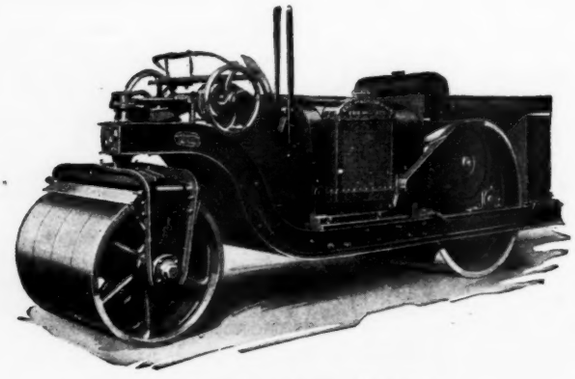
CONCRETE BREAKERS AND ELECTRIC PORTABLE HOISTS
The Sullivan Machinery Co., Chicago, Ill. Bulletin No. 76-G, Second edition. A 16-page illustrated catalog showing single and double drum electric portable hoists. Bulletin No. 81-I, Second Edition: Describes the heavy and light type concrete breakers.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

ERIE GASOLINE ROLLERS.

The Erie Machine Shops, Erie, Pa., are now producing in two sizes a tandem roller powered with gasoline units. The features of the steam type of roller manufactured by this company which have been retained in the new gasoline roller include the ability of instant reversal, proper distribution of weight, roller and ball bearings for carrying all moving parts, solid and low construction, and high clearance for rolling close to the curb, and over the curb if it is not more than fifteen inches high. The equipment used throughout is of the best, including Waukesha motors, twin disc heavy duty clutch with one-pin adjustment, Timken-Hyatt and SKF bearings and Modine radiators. All drive gears are accurately cut, hardened and ground. The power unit is mounted on a solid cast iron base which insures rigidity throughout.



ERIE GASOLINE ROLLER

AIR-DRIVEN HAND SAW.

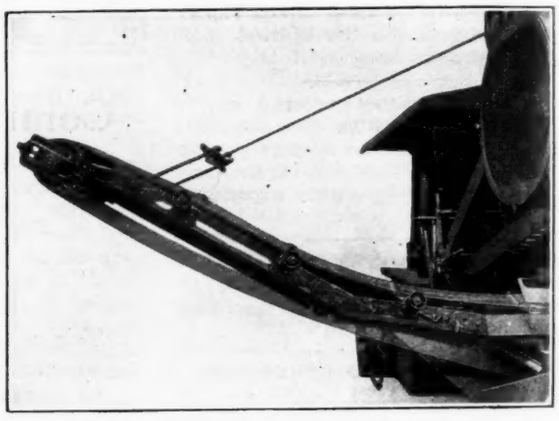
The Ingersoll-Rand Company, New York City, has devised a portable hand saw operated by compressed air which it claims will do five times the work of an ordinary saw at from 25 to 50 per cent of the cost. Different blades are furnished for wood, soapstone, bakelite, copper and other materials, and for cross-cutting and ripping. The 8-inch size weighs only 25 pounds. It is manufactured in three sizes, taking 6-in., 8-in. and 12.-in. blades.

It uses the 3-cylinder type of air motor, with the Crowe safety saw guard. This guard is of a telescopic nature, opening when the saw is applied to the material and automatically closing and locking in position when the cut has been completed, affording complete protection against accident or damage to the blade. The saw guard has an adjustable stop so that the saw can be set for the required depth of the cut. The parts are renewable and the cost of upkeep is said to be almost negligible.

HARNISCHFEGER CONVEYOR.

The Harnischfeger Corporation, Milwaukee, Wisc., has brought out a new conveyor (on which a patent is now pending) for their trencher. This can be shifted instantly by power from one side to the other, or to any intermediate point. By pulling one pin, it is convertible from the cradle type to the hinged and cable-supported type, which gives the advantage of raising or lowering the discharging end where trucks are to be loaded, or when this becomes necessary because of extra spoil from cave-ins or due to extra widths for depths. When moving from job to job, this ability to raise the conveyor by power after the removal of one lock pin is of great value.

Outside frame members have been eliminated, and a center frame, or backbone construction, used instead. The old-type conical belt rollers have been eliminated and straight ones used, thus forming a better trough for dirt and avoiding the use of dirt guides, which not only take up space, but shorten the life of the belt.



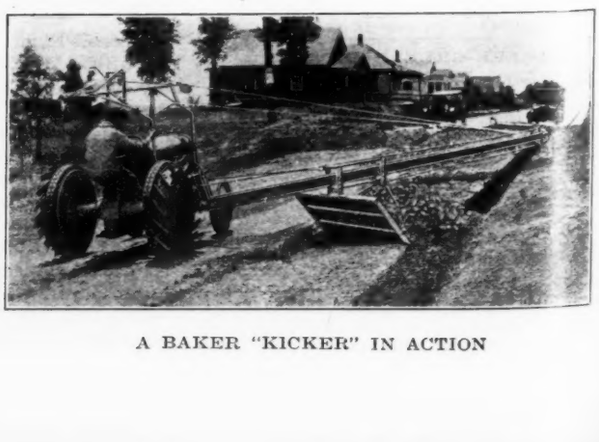
HARNISCHFEGER CONVEYOR

THE BAKER KICKER.

The Baker Steel & Machinery Co., Omaha, Nebraska, manufactures the Baker Kicker which consists of an auxiliary boom and bucket for the standard Baker-Fordson one-man-operated backfiller. The Kicker boom and bucket reverses the usual action of the backfiller, pushing the dirt into the ditch from the same side on which the machine is located, instead of pulling it in from the opposite side in the usual manner. The loaded bucket or scraper is pulled toward the end of the boom, away from the machine itself, instead of toward the machine.

It is especially handy for backfilling ditches that are laid near the curb, where the spoil bank is thrown toward the center of the street, occupying the space usually occupied by the backfiller. The boom may be set at any desired vertical or horizontal angle by means of the boom winch which is furnished as a part of the Kicker attachment.

INGERSOLL-RAND AIR SAW RIPPING 4" PLANK



A BAKER "KICKER" IN ACTION

The Kicker boom and bucket are instantly interchangeable with the standard boom and bucket, not more than 15 minutes being required for the change. It is constructed of two channels, 16 feet long, on which runs a roller carriage to which is hinged the scraper which is 48 inches long. Like the Standard Baker Backfiller, the Kicker is operated entirely by one man, and, according to the manufacturers, will backfill from 1,000 to 1,500 feet of 2 x 6 foot ditch per day.

BANNER STEEL POSTS FOR SIGNS

The American Steel and Wire Co., Chicago, Ill., manufacture the Banner steel posts, which are made from a rolled section, representing, it is claimed, an entirely new principle in post construction. They are built like a railroad rail, the head of the rail forming the back of the stem, and giving strength to resist strain in all directions. The posts are finished with a heavy coat of steel paint, baked on. Various lengths are available, 5 to 8 feet being standard, but longer posts can be furnished. Signs are fastened by heavy wire staples, clinched by a special machine. The edges of the sides of the post face are fluted, which is claimed to prevent wind vibration. Banner posts are driven either by sledge, or by a special one-man post driver. An unusual anchor plate construction is claimed to afford a very solid anchorage in the ground. These anchors which are adjustable for height, are riveted to the stem of the post.

BANNER STEEL POST

RUSSELL MOTOR PATROL

The Russell Grader Mfg. Co., Minneapolis, Minn., has announced the Russel Motor Patrol No. 5, which is an adaptation of the Russell grader and the Cletrac tractor. The No. 5 is designed for all-around use. The standard length of blade is 10 feet, but other lengths are furnished on order. The back of the blade is reinforced by two heavy angles; the circle supporting the blade is 52 inches in diameter, insuring rigidity. The blade is raised and lowered by a worm-gear, enclosed in a machined housing to protect it from the dust. Bronze bushings and collars are used on the worm shaft. Other features are lifting arm shafts of high carbon steel, keyed to both gear and lifting arms; provision for taking up wear in the worm and forward left-arm brackets; and ball and socket connection for lifting links.

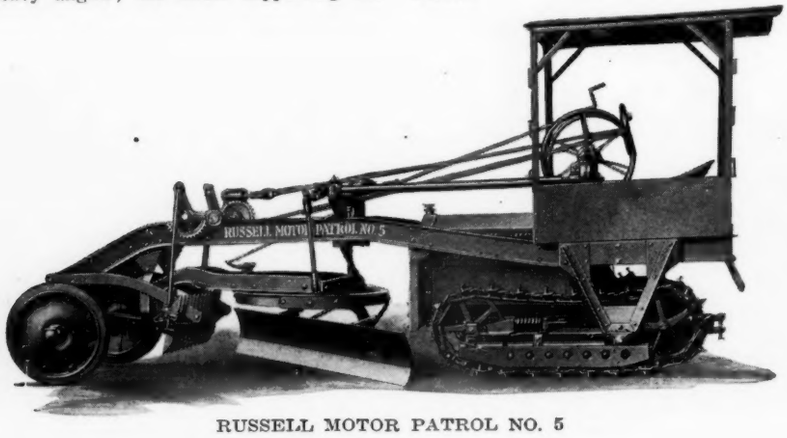
The center shift allows shifting the blade to either side of the frame. This shift is of the rack and pinion type, operated by worm and gear. Front wheels are 32x5 rubber tired, with Timken bearings.

The scarifier is independently adjustable from the rear platform, and will work with the blade or independently as desired. The operator's station is at the rear, giving full view of the work.

HAISS HI-POWER CLAMSHELL.

The George Haiss Manufacturing Co., New York, is introducing a small narrow-bowl bucket of half-yard capacity to meet the need for an economical type for use with the popular Bear Cat, Universal and other light cranes, for trench digging, and excavation in general. The rectangular shaped bowl is claimed to have one manifest advantage over a more or less square-bowl bucket of the same capacity. The digging power is directly proportioned to the length of the distance from the corner hinge to the center pivot. This new Haiss Bucket has the digging power of a big bucket, with the light weight and light-crane-size capacity of the half-yard bowl.

The illustration shows this and other details of interest: notably, the heavy round-forged connecting rods, the bowl bracing and the generous-diameter sheaves. It does not show one thing on which the manufacturer lays stress, and that is the concentration of weight in the lower sheave housing. This is pointed out as a particularly desirable thing, in that it does away with the need for counter weights. The claim is made that the mass weight of this Haiss bucket is so distributed that the jaws will open on any holding line and will dig its full bite in any ground that will yield at all to any other digging bucket.



RUSSELL MOTOR PATROL NO. 5

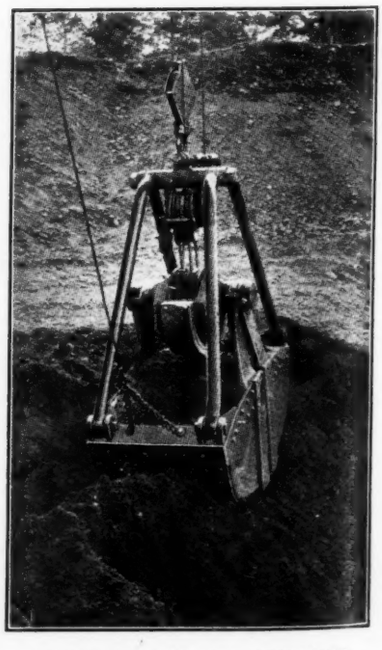
DEFIANCE MOTOR TRUCKS.

The Century Motor Truck Co., Defiance, O., manufactures two sizes of motor trucks. The model FRT has a capacity of 1½ to 2 tons, and is equipped with a 6-cylinder mono-block motor, with force feed lubrication, having a S. A. E. horsepower rating of 23.44, and an actual horsepower of 45. The wheels are of metal; the tires are 30 x 5 front and 32 x 6 rear pneumatic. The bumper is integral with the frame. Standard equipment includes motometer, generator battery, electric lighting and starting system, and spot and dash lights. The model EVT is a 2 to 2½ ton truck, having a 4-cylinder motor with force feed lubrication and a 5-bearing crank shaft, four forward speeds and reverse, wood wheels, and solid tires. Electrical equipment is not furnished with this model. The chassis weight of the FRT is 3,400 pounds, and of the EVT 4,100 pounds.

AVERY POWER MAINTAINER

The Avery Power Machinery Co., Peoria, Ill., has brought out a new model power road maintainer with straight reversible 12-foot blade and scarifier. This machine is designed and built for maintenance and light grading work, and is complete in itself with power plant and blade combined in one unit, and is under one man's control. Its original design is claimed to make possible a number of specially desirable features for highway officials and contractors. Among these are a special blade location for heavy cutting or grading work, the blade being placed diagonally between the drive wheels, thus making the drivers and the heavy rear end of the machine absorb the side draft. For maintenance work the blade is easily swung into position, ahead of the rear drivers, where it can be given any desired angularity for maintenance work.

The blade is carried on a movable



HAISS HALF-YARD BUCKET

Good Roads Service

TO YOU, a buyer of road building equipment, it means something to have an experienced man close at hand. And it means just as much to Good Roads to have such men interpret your needs to us. That is why we have patiently developed a field organization alive to the construction trends and placed them so that there is a Good Roads Representative near you. Boston, Atlanta, Portland—Good Roads service is within easy reach. Take advantage of it.

Makers of

Road Graders
Road Drags
Road Oiling Machines
Heating Kettles
Rock Crushers
Steam Road Rollers
Tandem Rollers
Motor Road Rollers
Corrugated Culvert Pipe
Gravel Screening Plants
Car Unloaders
Road Plows
Rooter Plows
Drag Scrapers
Wheel Scrapers
Dump Wagons
Sand and Gravel Plants
Street Sweepers

THE GOOD ROADS MACHINERY CO., Inc.
KENNETT SQUARE, PA.

Makers of the famous Good Roads Snow Plows

Factories: Kennett Square, Pa., Marathon, N. Y.

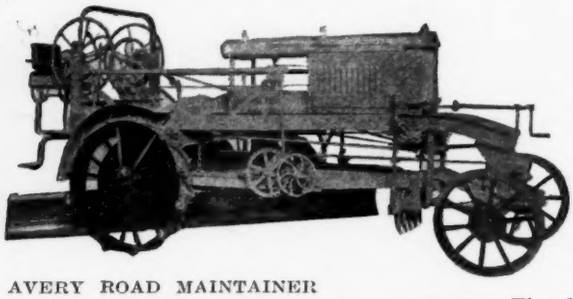
Good Roads MACHINERY
TRADE MARK

Watertown, Mass. . . . 36 Pleasant St.
Portland, Ore. . 3rd & Hawthorne Sts.
San Francisco, Cal. . . 26 Fremont St.
Los Angeles, Cal. . 931 Santa Fe Ave.
Chicago, Ill. . . . 49th & Halsted Sts.
Pittsburgh, Pa., . . . 1523 Oliver Bldg.
Atlanta, Ga. . . . . 569 Whitehall St.
New York, N.Y. . . . . 50 Church St.
Philadelphia, Pa., 2037 Commercial Trust Bldg.

Good Roads MACHINERY

turntable underneath the machine and pressure is applied to it at four points, thus preventing any frame distortion.

Its location also makes possible a shorter wheel base than is customary and, as a result, this machine will turn readily in a 28-foot circle.

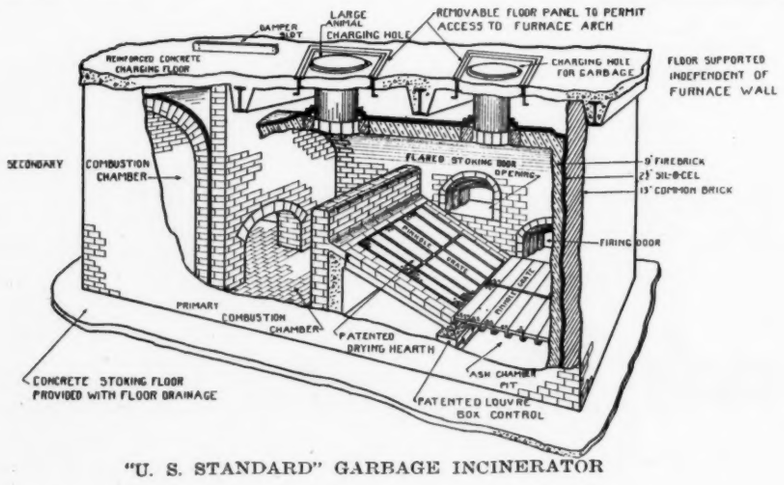


AVERY ROAD MAINTAINER

The power plant consists of a 4-cylinder heavy duty Waukesha motor. All gears are enclosed and run in oil; full roller and ball bearing equipment is used, Alemite lubrication, and a Gascolator fuel strainer are other features of construction. Either solid rubber tires or steel wheel equipment can be furnished, as desired.

UNITED STATES STANDARD GARBAGE INCINERATOR

The Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa., manufactures the United States Standard garbage incinerator. This is of the high temperature type, a temperature of 2,000 degrees being maintained in the combustion chambers, it is claimed. It consists of a drying hearth, a burning hearth, and combustion chambers, all being surrounded by an insulating lining of Sil-o-Cel, an insulating brick. The upper floor of the building is the charging floor from which the garbage is fed into the furnace. A distinguishing feature is the patented sloping hearth, which, it is stated, provides maximum drying facilities for the garbage, since all hot gases and flames pass from the burning hearth directly over the wet garbage on the drying hearth. It is claimed that pre-heaters are unnecessary. A feature of this furnace is the full semi-circular arch, which is claimed to eliminate the possibility of failure of the arch or the furnace walls.



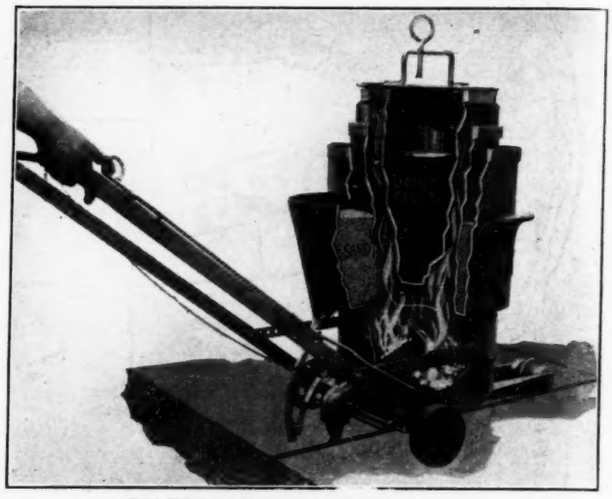
"U. S. STANDARD" GARBAGE INCINERATOR

JOINT POURING MACHINE

The Heltzel Steel Form and Iron Co., Warren, O., has developed a rapid joint pouring machine, which, it is claimed, heats, pours, and sands in one operation. It is so constructed that the fire is between the joint filler and sand compartments. The filler discharge pipe passes through the fire box maintaining a uniform heat and causing the discharge nozzle to deposit the filler at a uniform temperature. This nozzle discharge is controlled by a needle valve.

Inasmuch as the filler is heated at the time of pouring it penetrates clear to the bottom of the joint. A 90 per cent heating efficiency is claimed, and the machine also heats and drys the sand for pouring on grades.

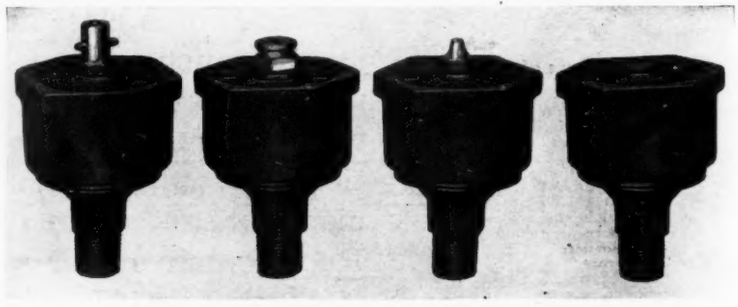
The flow of sand and filler is controlled by hand handles which are adjustable as to height. No bridging is necessary and the broad tread wheels do not mar the concrete. A pilot wheel running in the joint insures perfect alignment. The sanding compartment is recommended for use on grades to prevent the filler from flowing out but is not necessary except on grades. A fire box is provided for any kind of fuel or is equipped with oil burner when desired.



HELTZEL JOINT POWER

LINK-BELT HEX-TOP GREASE CUPS

The Link-Belt Co., Chicago, Ill., has just brought out a new "Hex-Top" malleable iron compression grease cup with alemite or Zerk fittings. It is claimed that the combination of compression grease cup and Alemite fitting is an improvement over either article used separately. These cups may be filled readily, even in relatively inaccessible places, by means of the grease gun, while if a grease gun is not at hand, and a bearing gets warm, a turn or so of the cup will take care of the emergency.



LINK-BELT HEX-TOP GREASE CUPS

ANDREWS SELF-LOADING AND ELEVATING PLANT

The Andrews Manufacturing Co., Minneapolis, Minn., manufactures a self-loading and elevating cart which, it is claimed, has unusual adaptability. It will handle earth or snow, either into the cart itself, or by means of an elevator, into a truck or to a waste pile. In earth work, the blade gathers up a furrow of earth and lifts it, through the rolling action of the wheel into the cart, or into a conveyor. There are only two moving parts—the wheels. The usual rate of loading is claimed to be 2 cubic yards per minute. When the point to

Installation for one of the largest gas companies in the middle west. 12" plain end deLavaud pipe with Dresser type couplings.

The smooth exterior of deLavaud Cast Iron Pipe makes it ideal for use with special couplings

IT has long been a standard practice to use couplings of the Dresser type for high pressure lines.

For water or natural gas lines this joint may be equipped with regular rubber gaskets. For lines conveying manufactured gas, lead tipped gaskets are generally specified.

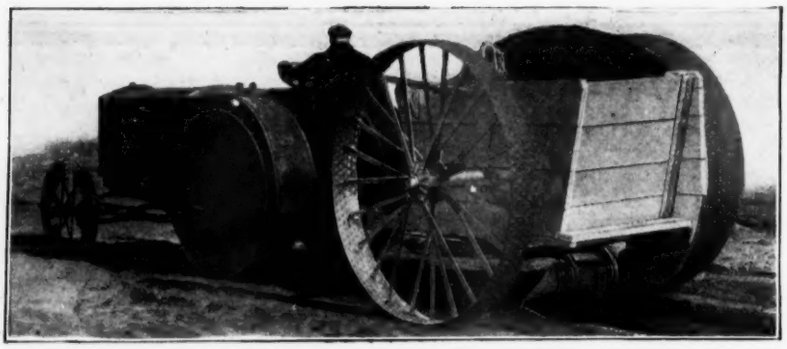
Write for descriptive literature on special couplings for all purposes

United States Cast Iron Pipe and Foundry Company

General Offices:
Burlington, New Jersey

SALES OFFICES

Philadelphia: 1421 Chestnut St.
Chicago: 122 So. Michigan Blvd.
Birmingham: 1st Ave. & 20th St.
Buffalo: 957 East Ferry Street
Cleveland: 1150 East 26th Street
New York: 71 Broadway
San Francisco: 3rd & Market Sts.
Pittsburgh: 6th & Smithfield Sts.
Dallas: Akard & Commerce Sts.
Kansas City: 13th & Locust Sts.
Minneapolis: 6th St. & Hennepin Ave.



ANDREWS SELF-LOADING CART

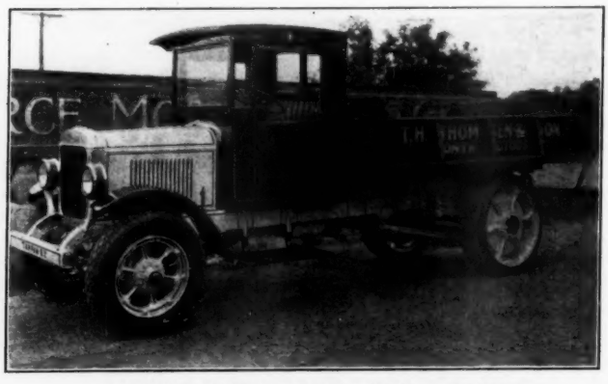
be excavated is reached, the plow is dropped. When the cart is full, the plow is raised and the load hauled to the point of disposal. One man operates the equipment. The bottom dump doors of the cart are closed with a single swing of a lever.

Each cart is provided with its own plow and operating mechanism, convenient to the driver, and only a linchpin is required to attach the cart to the tractor.

Carts are made in all sizes to accommodate any tractor. A specialty is the 6-yard capacity earth loading carts for 10-ton tractors. These carts are designed to work in tandem, with two in a train, delivering 12 cubic yards per round trip. Because the outfit is constantly in motion, a low yardage cost is obtained, it is claimed.

RELAY AXLE-DRIVE MOTOR TRUCK.

The Relay Motors Corporation, Wabash, Ind., manufactures a motor truck equipped with the relay drive, which, it is claimed, is an important forward step in transportation development. The main point of difference between the relay drive and the conventional type of drive is the method employed to roll the rear wheels along the road. In the Relay truck the drive is by internal pinions on a circular track on the interior of the wheel perimeter. The advantage claimed for this method is that the load, which is on a live axle, is moved away from the point where the wheel makes contact with the ground and thereby causes the wheel to move in a similar direction. This, it is claimed, eliminates slipping and spinning of the wheels and promotes smooth riding. Exceptional ability in negotiating mud, deep sand, and soft ground is claimed for this truck.



RELAY AXLE-DRIVE MOTOR TRUCK

INDUSTRIAL NOTES

SPEEDER MACHINERY CORP. MOVES

The Speeder Machinery Corporation has moved its factory and general offices from Fairfield, Ia., to Cedar Rapids, Ia. Speeder cranes and shovels are now being built in a new brick and steel factory with a capacity of one complete Speeder a day.

CHLORINE APPARATUS FOR CHILI.

Wallace & Tiernan Co., Inc., within the last few months have made several large export shipments of chlorine control apparatus to Japan, India, Brazil, Argentine, Uruguay, Chile, etc. The largest of these is forty-four of the new Type MSP and MDP chlorinators for the Inspeccion de Agua Potables y Desagues of Chile.

WESTINGHOUSE MOTORS FOR PHILADELPHIA SUBWAY CARS.

Driving motors, electrical controls, and other equipment for Philadelphia's North Broad Street subway are being supplied by the Westinghouse Electric and Mfg. Co. Two 210 h.p. motors will be used in each car, giving a speed of 47 miles per hour. All conceivable safety control devices are included on these cars. Each car will be equipped with five ceiling fans. Provision is made for lighting of cars by storage batteries in case power is shut off. There are 6½ miles of track on the North Broad Street subway. Expresses will make the round trip of 13 miles in 32 minutes, while locals will require 42 minutes.

NEW DISTRIBUTORS FOR NOVO ENGINE CO.

The Novo Engine Co., Lansing, Mich., has appointed the Construction Equipment Co., Columbia, S. C., to serve South Carolina; the San Antonio Machine Supply Co., San Antonio, Tex., with branches at Corpus Christi and Waco, to serve the south central part of Texas; and the H. E. Erickson Co., Inc., Minneapolis, Minn., to cover the north central territory.

CELITE PRODUCTS COMPANY.

Recent appointments to the engineering staff of the concrete department of the Celite Products Co., are Clyde E. Beckett, formerly with L. E. Myers Company of Chicago, and George S. Holland, formerly of the engineering department of Des Moines, Ia.

HARNISCHFEGER SALES CORPORATION.

George W. Gimlich has been appointed manager of the branch at Dallas, Tex., of the Harnischfeger Sales Corporation, succeeding Daniel J. Murphy, who will open an office for the company at Baltimore.

MOHAWK ASPHALT HEATER CO.

R. E. Piper, 1522 Broad St., Richmond, Va. has been appointed authorized distributor for Mohawk Oil Burner Equipment and for the Hotstuf Ashphalt Heater.

TOPPING MACHINERY CO. MOVES.

The Charles T. Topping Machinery Co., Dayton, O., manufacturer of the Topping Pony Ditcher, has removed its general offices from the plant of the Smith Gas Engineering Co., Dayton, O., to the U. B. Building, Dayton, O. Several improvements in the design of the Pony-Ditcher are also announced.

R. H. BEAUMONT CO. TAKES OVER AMERICAN MFG. & ENGRG. CO.

R. H. Beaumont Co., Philadelphia, Pa., has taken over the business of the American Mfg. & Eng. Co., of Kalamazoo, Mich., and products formerly manufactured by this company, including the American slack line cableway excavator, will now be manufactured by the R. H. Beaumont Co. S. O. Nafziger, president of the American Mfg. & Eng. Co., will be associated with R. H. Beaumont Co.

The addition of the American slack line cableway excavator to the Beaumont line, which already includes the Beaumont LeClair cable drag scraper, completes a full line of equipment for the elevating and storing of sand, gravel, stone and kindred materials.

THEW SHOVEL CO. APPOINTS EXPORT MANAGER.

The Thew Shovel Co., Lorain, O., has appointed Paul Malenchini as manager of its export department with headquarters at the general offices at Lorain, O.

SPRAGUE HOISTS.

The entire Sprague portable hoist business of the General Electric Company was taken over April 1st by the Shepard Electric Crane & Hoist Company of Montour Falls, N. Y., which has established for this purpose a division known as the Sprague Hoist Division of the Shepard Electric Crane & Hoist Company, with offices at 30 Church Street, New York City. N. A. Hall, of the General Electric Company, will take charge of the new Shepard division, after 14 years of service with General Electric.

The Definite Measurable Savings You Make with the (R-B) Method of Curing Concrete Roads

"Cheaper Than Dirt" is a slang expression, of course, but when applied to the "R-B" method of curing concrete it becomes a literal fact and good English—because it costs you considerably less than the old earth or straw method. Here is what "R-B" method will do for you:

1. *Prevents Storage Cost.* "R-B" grade of Silicate is shipped you in steel drums, which can be hauled direct from the freight car and spaced on job according to needs.

2. *Cuts Cost of Application to a Minimum. One man* can apply "R-B" to all the concrete laid in one day by your mixing machine.

3. *Eliminates Covering, Sprinkling and Cleaning of Road.* That means fewer men, lower pay roll and less labor trouble.

4. *Permits Maximum Operation.* No sprinkling is necessary with the "R-B" method of curing concrete; therefore, where water supply is limited, all the available water can be employed for mixing purposes.

5. *Cuts Pumping Cost in Half.* When earth or straw are used for curing it is necessary to have double the size of pump, or two smaller pumps to furnish sufficient water for both sprinkling and mixing. This means a larger outlay for you in money and fuel.

6. *Pipe Lines Can Be Removed When Concrete is Laid.* When you have several miles of concrete road to lay, your investment in pipe is high. The sooner you can take up the pipe and move it with the mixer, the less capital you have to invest in pipe.

All these and many more savings are covered fully in our "R-B" Booklet, which we will gladly send you upon request.

The Grasselli Chemical Company **Established 1839** **Cleveland**

New York Office and Export Office: 347 Madison Avenue, Corner 45th Street

Albany	Charlotte, N. C.	Milwaukee	Philadelphia
Birmingham	Chicago	New Haven	Pittsburgh
Boston	Cincinnati	New Orleans	St. Louis
Brooklyn	Detroit	Paterson	St. Paul

GRASSELLI (R-B) SILICATE of SODA

The Shepard Company will furnish spare parts for obsolete types of Sprague hoists as well as for the current line. The General Electric Company will continue to manufacture the parts for motors which have been used on Sprague hoists, and parts for controllers and brakes, but this business will be handled commercially by the Shepard Company.

CELITE AND WORKABILITY OF CONCRETE.

In tests conducted by Messrs. Pearson and Hitchcock at the U. S. Bureau of standards, the workability of Celite concrete was found to be from 50 per cent to 100 per cent greater than that of plain concrete; these determinations being made by means of a special workability machine designed at the Bureau.

This increased workability is reflected in lower labor costs in the field. On large projects the number of men required to handle the concrete from the mixer until it is finally in its place in the forms can be reduced considerably. On smaller jobs where a reduction in the force is not advisable, the placing can be accomplished in a much more satisfactory manner with greatly reduced effort. An eastern manufacturer of concrete block used three men to work the concrete into the forms and it was necessary to actually spade each block before using Celite. With Celite only two men are needed and much better blocks are being produced. The third man is used to speed up an earlier stage of the operation and the result has been an increased capacity of approximately 6 per cent.

WHITE BUSINESS INCREASES

March deliveries of White trucks were 74.5 per cent greater than February sales and exceeded those of any month since September, 1926. March sales were also correspondingly increased.

The White company is now delivering to various municipal departments of the city of New York 126 trucks, which will increase the number of White trucks owned by the City of New York to 1,072 units. Included in those being delivered are 52 heavy and 4 light trucks for street cleaning work in Queens; 50 heavy trucks for street cleaning in Manhattan, Brooklyn and Bronx; 7 light trucks for ambulance work; 8 heavy trucks for street work in Manhattan and Bronx, and one heavy truck for oil distribution work.

O. K. CLUTCH AND MACHINERY CO.

C. W. Ferguson, formerly advertising manager of the Speeder Machinery Corp., Cedar Rapids, Ia., has been appointed sales manager of the O.K. Clutch and Machinery Co., Columbia, Pa. A number of new distributors will be appointed in the near future, and the company plans to add several new items to its line.

BOOK REVIEWS

Water Purification Plants and Their Operation. By Milton F. Stein. John Wiley & Sons, Inc. 3rd edition. 105 illustrations. 312 pp. $3.

The third edition of this book differs from the second edition principally in that there are added in the form of appendices, data on the interpretation of bacteriological tests, the colloidal theory in water purification and hydrogen-ion concentration. Various parts of the book have been rewritten and brought up to date.

Primarily this book is intended to be a manual for filter plant operators, but it also contains informations regarding the general field of water purification, including data on the impurities often found in water, physical, chemical and bacteriological tests, and the interpretation of tests.

Waterworks Handbook. Flinn, Weston, and Bogert. 3rd Edition. McGraw-Hill Book Co. 338 ills., 871 pages.

In the ten years since the Waterworks Handbook first appeared, it has become so well known that it requires only a brief mention. The third edition has been brought up to date; parts of the old text have been rewritten, and other parts rearranged. As stated in the preface, the book gives a usable compilation of information to all engaged in the waterworks field. It is intended for those comparatively skilled in the field rather than for the beginner.

The sections and space devoted to each are as follows: Sources of Supply, 80 pages; Collection, 188 pages; Transportation and Delivery, 112 pages; Distribution, 202 pages; Character and Treatment, 164 pages; Hydraulics and Materials, 90 pages.

Military Sanitation. The Army Medical Bulletin No. 15. The Medical Field Service School, Carlisle Barracks, Pa. 47 Illustrations; 246 pages.

This is probably the best practical text book on field sanitation and public health engineering now available. It should be of value to many engineers, especially those engaged in health work, or in charge of labor camps on reservoir, tunnel or other work requiring the use of large forces of men.

Water supply is covered rather briefly, most of the space being devoted to field water supply. The data on emergency treatment, disinfection and testing are valuable. The chapter on foods, covering the subjects of rations, food conservation, food poisoning, and forms for inspection of messes, should prove of particular value to those engaged in the lines of work mentioned above.

Few realize that one of the greatest factors in the prevention of spread of the respiratory diseases is such a simple matter as the provision of ventilation and floor space, yet British medical officers found during the world war that an increase in floor and air space effected a greater reduction in meningitis than any other factor. The control of intestinal diseases is largely accomplished through sewage disposal, water purification and fly control. The control of mosquitoes, perhaps the most important insect carriers of disease, is also an engineering problem. Practical data are given on control of insects, including fleas, lice, bedbugs, rats, ticks, flies and roaches.

The chapter on disposal of wastes has reference mainly to military conditions. An excellent small incinerator is illustrated, and some good advice given regarding garbage collection and disposal. Camp sanitation and the location of camp sites are covered in a direct and instructive manner.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, etc., required by the Act of Congress of August 24, 1912, of Public Works, published monthly at New York, N. Y., for April 1st, 1927.

State of New York, County of New York, ss.: Before me, a Notary Public in and for the state and county aforesaid, personally appeared James T. Morris, who, having been duly sworn according to law, deposes and says that he is the business manager of Public Works, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and, if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor and business editor and business manager are:
Publisher—Public Works Journal Corporation, 243 West 39th Street, New York, N. Y.
Editor—A. Prescott Folwell, Montclair, N. J.
Managing Editor—A. Prescott Folwell, Montclair, N. J.
Business Manager—James T. Morris, White Plains, N. Y.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent. or more of the total of stock.)
Public Works Journal Corporation, 243 West 39th Street, New York, N. Y.
Sumner W. Hume, 243 West 39th Street, New York, N. Y.
James T. Morris, White Plains, N. Y.
A. Prescott Folwell, Montclair, N. J.
Contracting Pub. Co., New York, N. Y.
Stockholders of Contracting Publishing Co.:
H. F. Pomeroy, 33 W. 42nd St., New York, N. Y.
J. R. Breuchaud, 342 Madison Ave., N. Y. City.
Frank W. Skinner, 20 Vesey Street, N. Y. City.
H. F. Hackerdorn, Consumers Bldg., Chicago, Ill.

3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are:
Swetland Publishing Company, 239 West 39th Street, New York, N. Y.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also that the said two paragraphs contain statements embracing affiant's knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association or corporation has any interest, direct or indirect, in the said stock, bonds or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is (This information is required from daily publications only).

JAMES T. MORRIS, Business Manager.

Sworn to and subscribed before me this 1st day of April, 1927.
(Seal) H. H. MINER,
Notary Public, No. 228, New York County,
Register's No. 8051
(Commission Expires March 30, 1928)

Taping on high voltage leads on the primary side of three phase transformer.

The Mark of Quality

A Small Part of the Cost

A BIG PART

in the Performance—

Firestone Friction Tape, an item of small cost plays a vital part in the efficient operation of expensive electrical apparatus. It surpasses Government specifications and those of the American Society for Testing Materials. High dielectric properties. Exceptional tensile strength. Adhesive rubber compound virtually impervious to weather and temperature conditions. For prices and specifications write the Home Office at Akron, Ohio, or the nearest Branch.

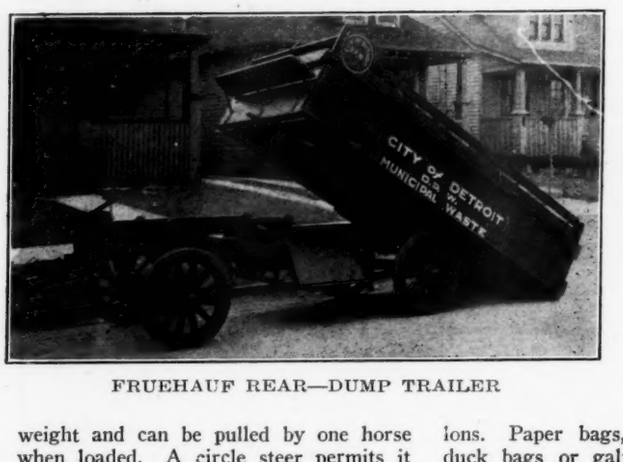
Firestone

Friction Tape

AMERICANS SHOULD PRODUCE THEIR OWN RUBBER..... Harvey S. Firestone

FRUEHAUF TRAILERS.

The Fruehauf Trailer Co., Detroit, Mich, manufactures drop-frame, rear dump and other types of trailers. The rear-dump is especially recommended for collecting garbage, ashes and other municipal wastes. It is rugged but light in weight and can be pulled by one horse when loaded. A circle steer permits it to turn at a right angle. One man can dump the load, tripping a lever and giving the body a slight push. The capacity is 4 to 6 yards, as desired. The wheel base is short, making for easy hauling. It has Timken roller bearings and Alemite lubrication.



FRUEHAUF REAR—DUMP TRAILER

GRUSS AIR SPRINGS.

The Cleveland Pneumatic Tool Co., Cleveland, O., manufactures Gruss air springs for trucks, buses, and passenger cars. It is claimed that by their use six distinct advantages are obtained: A reduction in repair bills; a saving in lost time, due to fewer repairs and less maintenance; prevention of upward throw and side sway; less cost in operation; increased average speed, due to better roadability of trucks, cars, or buses equipped with Gruss springs; and a longer life.

There are two main units, one the outside housing, the other the inside sliding unit. The former fastens to the frame, the latter to the spring. The upper air chamber is filled with compressed air through the air valve, thus suspending the vehicle on a cushion of air, which, it is claimed, absorbs all shocks and vibration. A recoil chamber prevents rebound and smoothes out the shock due to road obstructions.

SOLAR SELF-CLOSING RECEPTACLES.

The Solar-Sturges Mfg. Co., Melrose Park, Ill., manufacture the Solar self-closing receptacles for waste and rubbish. There are nine sizes of these, ranging in height from 6 to 36¾ inches, and in capacity from 2 gallons to 65 gallons. Paper bags, burlap bags, white duck bags or galvanized cans may be used for containers. As a rule, the smaller cans use the paper bags, while the medium size are provided with galvanized cans, and the larger size with burlap bags. Solar receptacles are built of steel, have but one moving part, and are claimed to be proof against fire, vermin and odor.

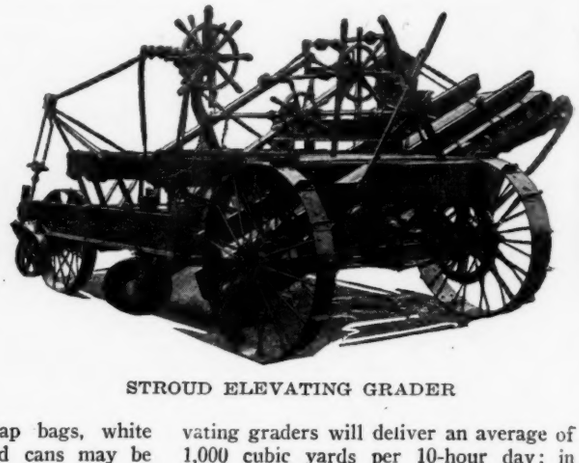
JAK-TUNG TRUCKS.

The Howe Chain Co., Muskegon, Mich., manufactures a small 3-wheel truck, which consists of a platform equipped with two malleable iron wheels at the rear and a malleable iron draw bar in the front. The jack tongue, with wheel, hooks into the draw bar leg and, by a downward thrust of the handle, the load is raised, and may be hauled anywhere. Jak-Tung trucks are built in 17 different sizes and in 3 models, with either steel or hardwood platforms or trays, and have a capacity up to 3 tons.

STROUD ELEVATING GRADERS.

J. O. Adams & Co., Indianapolis, Ind., is sales agent for the Stroud Elevating graders, which are furnished in three different sizes or models. The "Stroud Senior," which has a 36-inch belt and weighs 9,975 pounds, is the size most used; the "Master" carries a 36-inch belt and weighs 11,682 pounds; the "Heavy Duty" has a 42-inch belt and weighs 11,790 pounds. These models are regularly equipped with carriers 16 feet long, but extensions can be furnished to increase their length up to 21 feet.

In wagon loading work, Stroud elevating graders will deliver an average of 1,000 cubic yards per 10-hour day; in straight casting work, as on embankments, where the grader is kept running continuously without loss of time for wagon stops, 1,500 cubic yards or more may be handled.



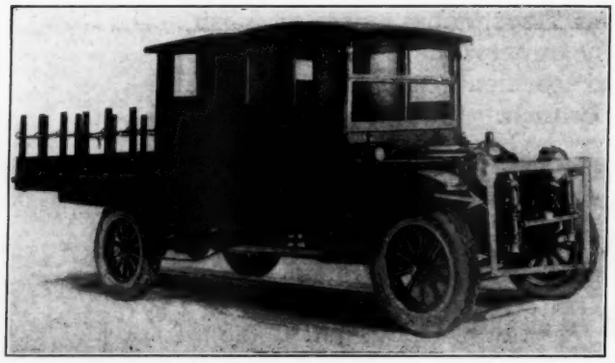
STROUD ELEVATING GRADER

Like all elevating graders, the Stroud plows a furrow of dirt which is turned over on an endless conveyor. The conveyor carries the dirt up to the end of the carrier and deposits it onto a roadway or embankment, or into a wagon for dumping elsewhere. Stroud graders, it is stated, differ from others principally in the strength of design, which is the result of many years of experience.

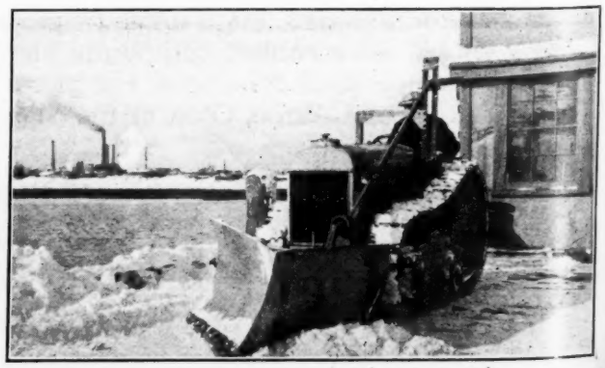
NEW ENGLAND SIDEWALK PLOW

The New England Structural Products Co., Everett, Mass., manufactures a plow for cleaning snow from sidewalks. When mounted on a new narrow-model Trackson Full Crawler (the Trackson Co., Milwaukee, Wis.), which is narrow enough to permit the outfit to go between terraces on one side and trees and posts on the other, it can go through drifts three feet high. It is equipped with snow grouters for extra traction.

The unit can be operated over curbs as high as 10 inches, and can travel at 7 miles an hour, pushing the snow to the gutter side only.



GRUSS AIR SPRINGS ON ST. PAUL WATER WORKS TRUCK



TRACKSON-FORDSON AND NEW ENGLAND SIDEWALK PLOW